PULP & PAPER

November 1982

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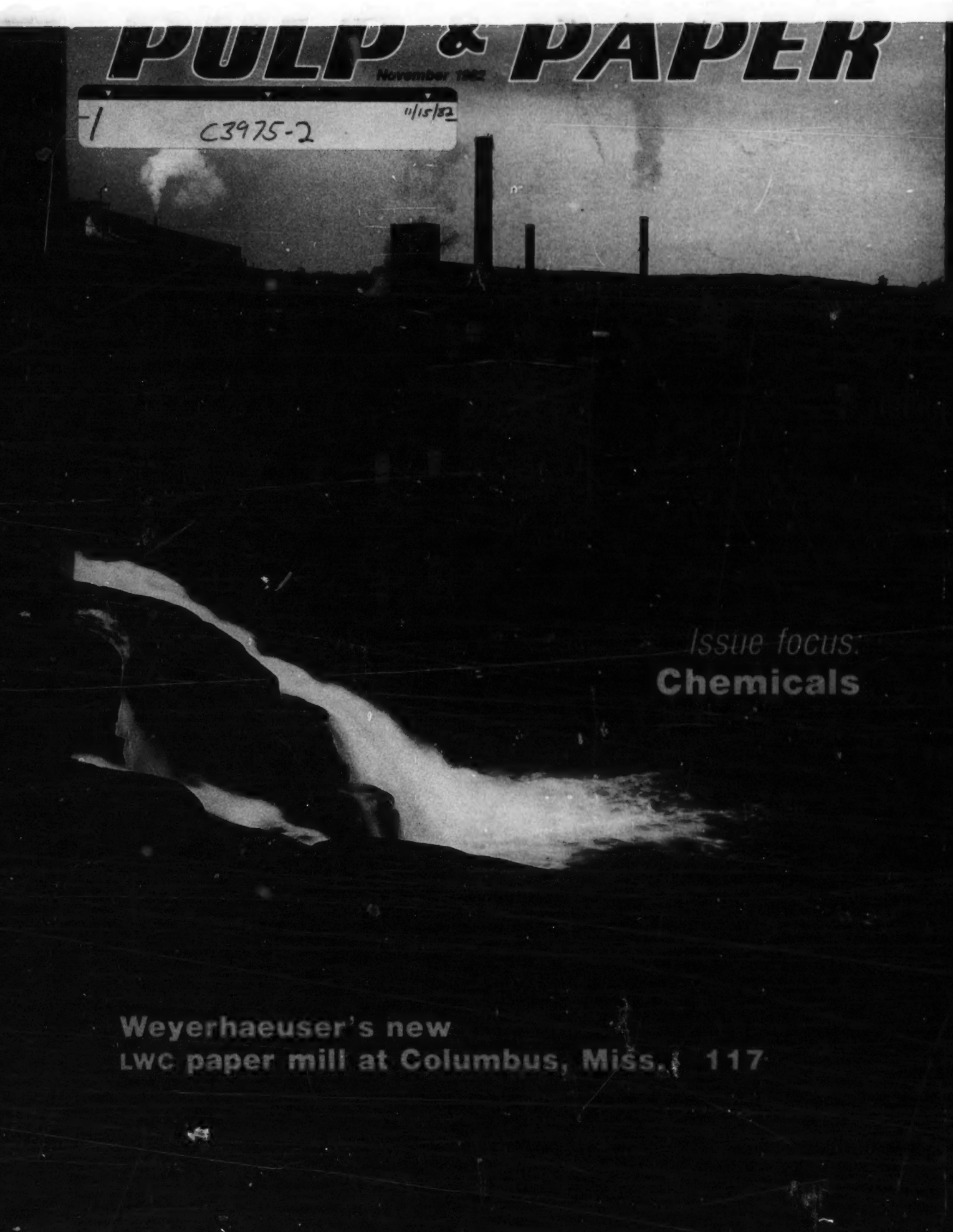

Issue focus:
Chemicals

Weyerhaeuser's new LWC paper mill at Columbus, Miss. 117

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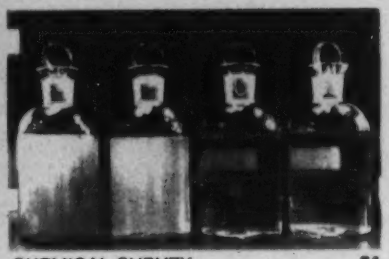
Volume 56 Number 11 November 1982

ISSUE FOCUS: Chemicals



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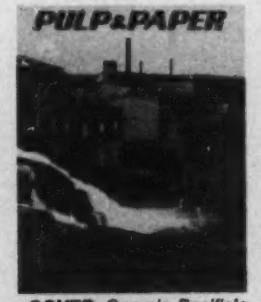

***COVER:** Georgia-Pacific's Lyons Falls, N.Y., printing papers mill has begun converting its power boilers to wood fuel for an annual savings of over 200,000 bbl of oil (see story page 146). Photo by Gary Nash, courtesy of Rader Cos. Inc., Portland, Ore.*

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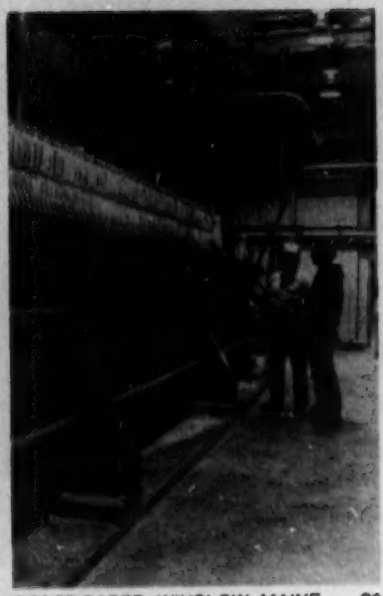

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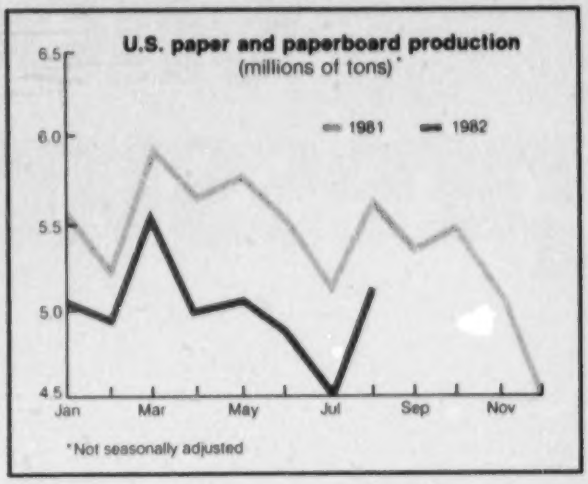
MONTH IN STATISTICS

U.S. paper and paperboard production in August totaled 5.1 million short tons, 4.8% below the August 1981 total, according to the American Paper Institute. Adjusted for seasonal and workday factors, the July-August production rate came to 58.8 million tpy, ahead of the second-quarter average of 57.8 million tpy but below the first-quarter average of 60.0 million tpy.

Among major grades, a modest uptrend was experienced in virtually all paper grades. On a seasonally adjusted basis, the August trend for printing/writing paper shipments was the highest for the year, API said. Packaging and industrial grades showed fairly strong growth in the month. Newsprint production, however, eased slightly in August. In paperboard, August unbleached kraft linerboard output was second only to the March level—supported to some extent by exports—but was still below year ago. Boxboard grades showed similar strength.

Total Canadian newsprint shipments in August came to 598,000 metric tons, down 8.4% from August 1981, according to the Canadian Pulp & Paper Assn. Newsprint mill operating rates climbed to 75% in August from 71% in July but were well below the 82% rate of a year earlier.



		Latest month (000 short tons)	% change from year ago	Annualized year-to-date (000 short tons)	% change from year ago
PAPER & PAPERBOARD PRODUCTION[1]					
Newsprint	August	410	−12.6	5,146	−1.6
Uncoated groundwood (s)	August	130	1.6	1,434	−2.9
Coated paper (s)	August	437	3.8	4,968	1.0
Uncoated free sheet (s)	August	650	0.2	7,792	−2.8
Unbleached kraft packaging and industrial (s)	August	326	−2.7	3,651	−8.1
Tissue	August	370	−6.8	4,395	−3.0
Total paper	**August**	**2,592**	**−2.9**	**30,345**	**−3.1**
Kraft linerboard, unbleached	August	1,206	−7.3	13,732	−8.7
Semichemical medium	August	349	−11.0	4,410	−9.5
Bleached paperboard	August	316	−5.1	3,767	−6.6
Recycled paperboard	August	572	−7.3	6,689	−7.4
Total paperboard	**August**	**2,543**	**−6.6**	**29,694**	**−8.1**
Total paper and paperboard*	**August**	**5,135**	**−4.8**	**60,039**	**−5.6**
PULP, WASTEPAPER & FIBER[2]					
Total woodpulp production	July	3,734	−8.5	50,118	−5.1
Market pulp production	July	382	−20.3	5,798	−6.3
Wastepaper consumption at paper/board mills	July	1,033	−7.4	13,665	−4.0
Pulpwood consumption (cords)	August	6,399	−1.9	79,114	−1.9
CONVERTED PRODUCTS STATISTICS[3]					
Corrugated box shipments (billion ft²)	August	20.414	−1.9	156.614†	−6.2
Containerboard inventories at box plants	Aug. 1	2,594	9.5		
INTERNATIONAL TRADE[3]					
U.S. paper imports (including products)	July	585	−5.5	7,945	−6.2
Imports of Canadian newsprint	July	449	−10.0	6,592†	−6.3
U.S. paper exports (including products)	July	357	0.3	4,298	−13.8
Exports of unbleached kraft linerboard	August	170	32.8	1,932	−4.8
Exports of woodpulp	July	261	−13.0	3,512	−5.8
CANADIAN STATISTICS[4] (reported in metric tons)					
Total newsprint shipments	August	598	−8.4	5,358†	−8.3
Operating rates	August	75%	82%	85%	94%
Inventories held by U.S. consumers	Aug. 31	1,502	3.2		
Woodpulp shipments (export only)	August	489	29.7	3,927†	−12.5
Operating rates	August	72%	62%	80%	86%

1. American Paper Institute. 2. API, Bureau of Census, American Pulpwood Assn. 3. Fiber Box Assn., Paperboard Packaging Council. 4. Canadian Pulp & Paper Assn. *Includes construction and wet machine grades. †Not annualized. ‡Not directly comparable to year ago because of coding change. (s) = shipments.

EMPLOYMENT

Second-quarter mill wages up a bit

Hourly wages of paper mill employees edged up in the second quarter from March levels to $10.82/hour. Weekly hours worked also rose slightly during the quarter while overtime hours held steady, bringing weekly paychecks to $477.16, up 3.8% from March levels, according to Bureau of Labor Statistics. Weekly earnings were up 6.5% over June 1981 levels.

Hourly wages also rose slightly for employees at paperboard container and box plants in the second quarter and, aided by small rises in weekly hours worked and overtime hours, brought weekly earnings to $331.70, a 3.7% rise over March levels and a 5.1% increase over year ago.

Production worker employment in the paper and allied products industry declined for the third quarter in a row and, at 489,000 workers, was 6.1% below year-earlier levels. Last year's employment peak was 525,000 workers in September.

The total number of women workers in the paper and allied products industry has steadily declined since its peak last September at 165,000 workers, and in May stood at 154,000 workers. The percentage of women workers has also fallen off slightly since September, down to 23.2% from 23.5%.

Average earnings and hours of production workers in the paper and allied products industry

	June 1982	Mar. 1982	% change for quarter	June 1981	% change year ago
Paper & allied (SIC 26)					
Hourly earnings	$9.27	$9.03	2.7%	$8.54	8.5%
Weekly hours	42.0	41.7	0.7	42.7	−1.6
Overtime hours	3.9	3.9	—	4.6	−15.2
Weekly earnings	389.34	376.55	3.4	364.66	6.8
Pulp & paper mills*					
Hourly earnings	$10.82	$10.50	3.0%	$9.98	8.4%
Weekly hours	44.1	43.8	0.7	44.9	−1.8
Overtime hours	5.7	5.7	—	6.3	−9.5
Weekly earnings	477.16	459.90	3.8	448.10	6.5
Paperboard containers & boxes					
Hourly earnings	$8.13	$7.94	2.4%	$7.50	8.4%
Weekly hours	40.8	40.6	0.5	42.1	−3.1
Overtime hours	2.9	2.8	3.6	3.6	−19.4
Weekly earnings	331.70	319.98	3.7	315.75	5.1

*Does not include figures for paperboard mills, which are similar.
Source: Dept. of Labor, Bureau of Labor Statistics

MERGERS

Diamond completes sale to Smurfit

Diamond International Corp. has concluded its sale of the assets of its packaging products, corrugated container, paperboard and graphic arts divisions to Jefferson Smurfit Group in a joint venture with Don J. Hindman and Clark Holdings Inc. of Chicago (P&P, Oct., p. 29).

The purchase price was about $80 million in cash, plus the assumption of certain liabilities. In 1981, the four divisions had aggregate sales of $190 million and income before taxes of $8.5 million.

Hammermill buys Millers Falls Paper

Hammermill Paper Co. has agreed to acquire Millers Falls Paper Co. from EG&G Inc. through an exchange of stock. Hammermill will operate the 30-tpd white paper mill in western Massachusetts as part if its Strathmore Paper Div.

Millers Falls Paper was profitable on sales last year of about $12 million. The mill produces cotton-content and sulfite bonds, onionskin, erasable, and technical papers on two 94-in. fourdrinier machines.

Strathmore already operates three mills in Massachusetts producing similar grades at Westfield, Woronoco, and Turners Falls, with a combined capacity of around 100 tpd. As part of a modernization program that will raise capacity by 40%, the division rebuilt one of its machines last year and has two more rebuilds scheduled for 1982-83.

WOOD PRODUCTS

G-P reopens idled plywood mill

Georgia-Pacific Corp. resumed production at its plywood plant at Logansport, La., Sept. 27, one year after 300 plant workers were laid off and the facility closed because of the depressed home building industry. The decision to reopen was based on "company marketing strategy, product sales, and the price and availability of raw materials needed for production," G-P explained.

Furloughed workers were recalled and full production output was expected to be reached within two weeks after start-up, the company said. Plant capacity is 180 million ft²/year.

Housing starts down 16% in August

Following a 34% jump in housing starts in July, August housing starts slumped 16.2% in August from the previous month to a seasonally adjusted annual rate of 1.195 million units, according to the Dept. of Commerce. Most of the August drop was due to a 31% decline in multifamily construction starts, while single-family units declined 2.4%. In July, multifamily unit starts more than doubled, aided by federal funds made available for government-subsidized construction.

Building permits also fell 16.6% in August, but the drop probably was due to builders waiting until October to seek permits to build more government-subsidized apartments. Dept. of Housing & Urban Development recently released funds for about 30,000 such units.

• **A new study** by the General Accounting Office reports there are "no quick fixes" to the severe problems of the home building industry. The study, delivered to Congress, says the demand for housing will increase "when interest rates decline substantially, provided it is accompanied by healthy levels of employment and growth in real personal income."

The study noted that imposing a duty on lumber imports from Canada might yield some short-term relief, but could entail trade repercussions and risk loss of future supplies of Canadian lumber. And any housing stimulus proposals under consideration by Congress must begin quickly, GAO claimed.

Construction paper and board: Recovery in housing in 1983 should aid ailing industry

U.S. Statistics	1980	1981	1982e
Construction papers			
Production, 000 tons*	1389	1150	1000
Capacity, 000 tons	2345	2272	2243
Imports, 000 tons	148	140	135
Exports, 000 tons	23	17	15
Apparent U.S. consumption, 000 tons	1494	1273	1120
Construction boards[1]			
Production, 000 tons	3020	2706	2400
Capacity, 000 tons	4389	4382	4349
Imports, 000 tons	210	231	242
Exports, 000 tons	55	108	160
Apparent U.S. consumption, 000 tons	3175	2829	2502

[1] Includes insulating and hardpressed boards; does not include wet machine boards e=estimated *All tons are short tons

Grade structure: Most construction papers are used to make felts for asphalt roofing tiles. Other applications include felts for cars and flooring, as well as sheathing and insulation. Insulation boards are used for wallboard, sheathing, ceiling tiles, and insulation deck board. Hardpressed boards—made from defibrated woodpulp and not generally considered a product of the paper industry—are usually denser than 31 lb/ft³. Uses include cabinets and wall paneling.

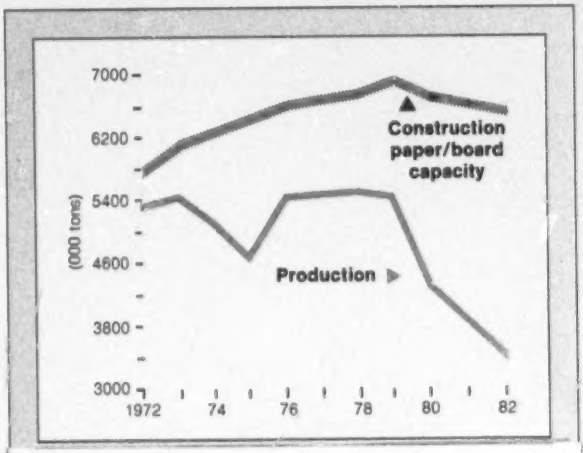
Production/capacity: Construction papers: In 1982, production is expected to drop to about one million tons, the lowest point in more than a decade and 15% lower than 1981's output of 1.15 million tons. Capacity for construction papers, which has been declining gradually for several years, is expected to drop slightly again in 1982 to 2.243 million tpy from 2.272 million tpy in 1981.

Construction boards: For 1982, construction board production will decline to 2.4 million tons, another record low point reached in this market. This represents a drop of 13% from 1981's output of 2.7 million. Production of insulating boards declined to 846,000 tons in 1981, 24% lower than the one million tons made in 1980. Hardpressed board production also dropped to an estimated 1.86 million tons made in 1981 compared with nearly 2 million tons in the previous year.

Construction board capacity is expected to remain relatively unchanged through 1983 at about 4.3 million tpy, with hardpressed board representing about 2.5 million of that.

Outlook: Demand for construction paper and board relies heavily on building activity, especially residential housing starts, as well as the level of home repair and retrofitting. In 1981, just 1.1 million new homes were built, the lowest level since 1946, and 1982 is expected to be relatively flat with just over a million new housing starts anticipated. A peak was achieved in 1979 when work was begun on 1.75 million new homes. In 1983, new housing starts should reach 1.3 million.

High interest rates were the chief barrier to more housing activity in the early 1980s, but observers say mortgage rates will drop about three points to near 14% in 1983. But other factors should put a lid on the market for some time. In addition to a trend toward building smaller houses that require less materials, competition from new products will also lower output. Fiberglass mat, which had an estimated 20% market share in 1981, should have about a 60% share by 1984-85, analysts say. Single-ply rubber roofing products are also making inroads into roofing. In the insulation market, inorganic materials such as foams should continue to displace such paper-based products as fiberboard insulation sheathing.



Estimated capacities for producers of construction papers:	Annual U.S. capacity (000 short tons)	Capacity share (%)
1. Celotex Corp.	281	12.5
2. Genstar Building Materials	190	8.5
3. GAF Corp.	166	7.4
4. Tamko Asphalt Products	137	6.1
5. Manville Corp.	123	5.5
6. Certain-Teed Corp.	120	5.3
7. Owens-Corning Fiberglas	54	2.4
8. Georgia-Pacific Corp.	45	2.0

U.S. capacity (1982): **2.243 million tons**
Capacity share of top five companies: 40.0%

Estimated capacities of insulation board companies:	Annual U.S. capacity (000 short tons)	Capacity share (%)
1. Celotex Corp.	365	20.3
2. Boise Cascade Corp.	154	8.6
3. U.S. Gypsum Co.	130	7.2
4. National Gypsum Co.	119	6.6
5. Conwed Corp.	95	5.3
6. Manville Corp.	95	5.3
7. Owens-Corning Fiberglas	81	4.5
8. Temple-Eastex Inc.	16	0.9

U.S. capacity (1982): **1.799 million tons**
Capacity share of top five companies: 48.0%

Masonite is the major producer of hardboard with an estimated 39% of the market, followed by Abitibi-Price Inc. (14.5%), Celotex Corp. (8.8%), Superwood Corp. (7.7%), Champion International Corp. (5.7%), and Georgia-Pacific Corp. (5.7%).

Pricing: Wholesale price index of building papers and board (1967-100): 1970, 101.2; 1972, 106.4; 1974, 123.5; 1975, 127.1; 1976, 138.8; 1977, 157; 1978, 187; 1979, 182; 1980, 206; 1981, 232; 1982, 240e.

Markets: Most construction papers/boards are converted into building products. Output by tonnage: construction papers, 30%; insulation board, 22%; hardpressed board, 48%.

Pulp/paper industry chemicals

PULP & PAPER's annual survey of chemical supply and prices indicates that demand is down; prices are somewhat weak, but rising

By BARRY SHOCKETT

☐ This has been a year of reduced demand for many chemicals used by the U.S. pulp and paper industry, leading in many cases to substantial discounting. A reduction in the transaction price of a number of chemicals is reflected by the year-to-year decrease in the industrial chemicals index (see Figure 1). In July 1982, the index was 349.7 compared with 370.4 a year ago. A similar turnaround in the fuels and power index was also reflected in lower petrochemical feedstock prices, although there were some exceptions.

For example, diethylenetriamine, used with wet-strength resins, has not decreased in price this year despite a sharp drop in the price of ethylene. Wet-strength resin prices have therefore continued to increase in 1982.

Pulp mill chemical demand in 1982 was depressed in most cases as pulp production has dropped off. By the end of July, output was down 4.5% over the corresponding 1981 period. As a result, 1982 usage of saltcake, soda ash, and sodium chlorate is below last year's levels.

Hydrogen peroxide usage is apparently breaking the general downward consumption trend for chemicals. Approximately 23% more H_2O_2 will be used by mills in 1982 than 1981. This is also the case in the Canadian market.

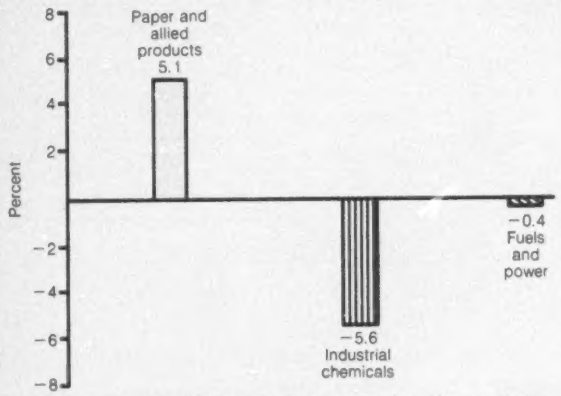
The chloralkali market has probably been affected most by the recession. The major end-use for caustic, the aluminum industry, is depressed in the U.S. and in offshore markets. Exports were down almost 50% by mid-year, compared to 1981 levels.

According to the Chlorine Institute, the average operating rate of the chloralkali industry for the first seven months in 1982 was 65% (5.6 million tons vs 6.7 million tons in 1981). Even though operating rates are low, the downturn in demand (particularly in aluminum) has produced a surplus of caustic soda, which is a significant turnaround compared to the first half of 1981.

Chlorine fared slightly better than its coproduct, caustic, with total demand down only 7% in 1982. Caustic demand was down 10%, even though discounting has been heavier and more prolonged. Some economists are predicting an increase in housing starts for 1983 of almost 35% and a boost in North American automotive production of about 22.5%. Both of these markets normally consume substantial quantities of polyvinyl chloride (PVC),

Mr. Shockett is consulting editor-chemical markets for PULP & PAPER.

FIGURE 1: **U.S. price increases for 1982***



* Only the paper and allied products index experienced a year-to-year increase during the first seven months of 1982.

Source: Wholesale price indexes, Bureau of Labor Statistics

supply, pricing

for which chlorine is a key precursor. If these markets revive, chlorine demand should surge.

Sulfur, the other chemical used in substantial quantities by the paper industry—besides caustic—that had been in short supply until last year, is also readily available. The downturn in its major customer, the fertilizer industry, has weakened demand considerably. Frasch and recovered sulfur production was down 14% in the first half of 1982 to 9.17 million metric tons (from 10.66 million for the same period last year).

Sulfur exports and imports were also down significantly at mid-year.

Production of most paper grades was down substantially in the first seven months of 1982. Coated papers output was barely ahead of last year's January-July period (0.4%) and, as a result, demand for both kaolin clay and starch will be down this year.

The sharp drop in paperboard output—almost 8.5% less in 1982 after seven months than in the previous year—will result in reduced requirements for latices, rosin size, and wet-strength additives as well.

DEFINITIONS OF SURVEY AVAILABILITY TERMS:

Very tight—On allocation or demand significantly greater than supply

Tight—Demand slightly greater than supply

Market—Supply and demand in balance, or excess capacity available

Calcium carbonate

Uses: About 85% of the calcium carbonate ($CaCO_3$) used in the paper industry is for coating, with the balance used as filler. Precipitated grades are used in about 70% of the applications, but ground natural carbonate continues to find increased usage as finer grades are introduced.

Demand: In 1981, the paper industry consumed an estimated 140,000 tons of $CaCO_3$. Although industry output was down almost 6% in the first half of 1982, the move by several mills to alkaline papermaking will help boost carbonate consumption to 140,000 to 150,000 tons this year. Other major uses include plastics, coatings, and refractories.

Sources: Producers are listed in the P&P *Buyers Guide 1982*, p. 32, "Register of coating and filler pigments."

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: Precipitated: 1982, $105-$170/ton, bulk, f.o.b. works; 1981, $95-$160/ton; 1980, $105-$135/ton; 1979, $98-$123/ton; 1978, $95-$133/ton. Ground, medium (15-micron): 1982, $105-$108/ton, bags, truckload, f.o.b. works; 1981, $95-$100/ton; 1980, $90-$95/ton; 1979, $82-$83/ton; 1978, $66-$76/ton.

Forecast: Precipitated carbonate prices rose about 6% in 1982 and should experience a similar increase next year. Medium-ground $CaCO_3$, on the other hand, increased about 8% in price and is expected to go up between 7% and 8% in 1983.

Caustic soda

Uses: Most of the caustic soda (sodium hydroxide) consumed by the pulp and paper industry is used by kraft and bleached sulfite pulp mills, mainly for caustic extraction in the bleach plant. Kraft and semichemical (NSSC) mills also employ some caustic for sodium oxide makeup. Organic and inorganic chemical production, textiles, and aluminum processing are other important uses.

Demand: Pulp mills in 1981 consumed an estimated 1.9 million tons of sodium hydroxide, or 17% of the 11.3 million tons produced. Mill consumption in 1982 is predicted to be down to about 1.7 million tons, with total caustic production for 1982 forecast to be about 10.2 million tons (down 10% from 1981). Organic and inorganic chemicals together use over 50% of the total, while textiles and aluminum processing each employ about 6%.

Sources: Caustic soda is a coproduct of chlorine production. See chlorine profile for major producers.

Availability: 1982, tight to market; 1981, very tight to tight; 1980, very tight; 1979, market; 1978, market.

Pricing: 1982, $315/ton, 50% solution, f.o.b. works, freight equalized; 1981, $270-$320/ton; 1980, $167-$200/ton; 1979, $130-$160/ton; 1978, $160-$170/ton.

Forecast: Caustic prices are also being discounted, but not to the same extent as chlorine prices. There have been reports of the selling price ranging between $190/ and $220/ton, but most caustic is sold at about $240/ton (about 24% below list). If the economy turns around in 1983 as predicted, the market price could increase about 30% during the year. Usually caustic soda supplies are adequate when chlorine demand is up. However, during most of 1982, caustic demand itself has been down substantially. With the predicted economic recovery next year, caustic supply could tighten up in the latter part of 1983. Pulp mill usage of caustic for 1983 is expected to increase between 5% to 6% and reach the 1.9-million-ton level.

Chlorine

Uses: The major end use for chlorine in the pulp and paper industry is as a bleaching agent in both kraft and sulfite pulp mills. Small quantities of chlorine are also employed for on-site manufacture of calcium or sodium hypochlorite used to bleach chemical or mechanical pulps.

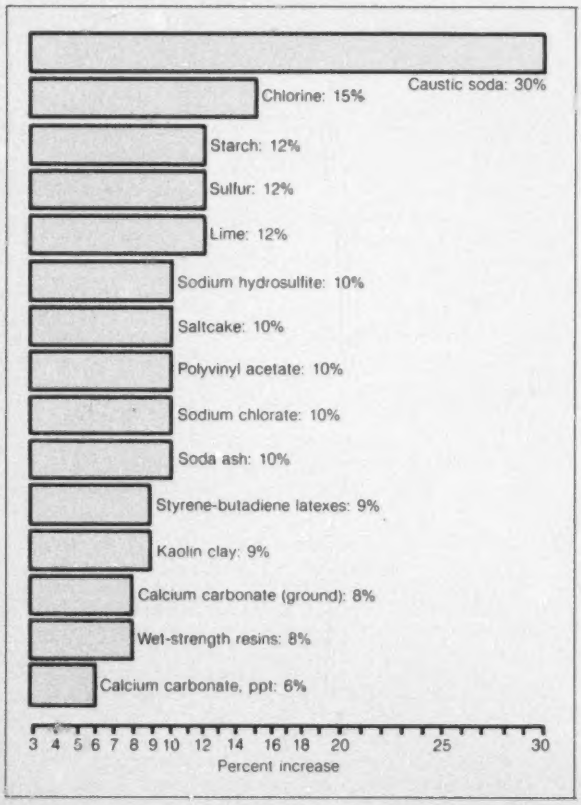
Demand: In 1981, chlorine demand by the pulp and paper industry was an estimated 1.4 million tons, about 13% of total production of 10.8 million tons. In 1982, mill consumption is expected to be about 1.3 million tons. Other major outlets include ethylene dichloride (EDC)—the intermediate for vinyl chloride monomer (VCM) manufacture—inorganic and organic chemicals, and municipal and industrial water treatment. Manufacture of EDC accounts for about 21% of the total.

Sources: There are approximately 25 companies in the U.S. making chlorine and caustic together by the electrolytic reduction of brine. (Relatively small quantities of chlorine are also produced by oxidation or electrolysis of hydrochloric acid.) The major chloralkali producers (in decreasing order of nameplate capacity) include: Dow Chemical, PPG Industries, Diamond Shamrock, Hooker Chemicals, Olin, Georgia-Pacific, Vulcan Materials, and Pennwalt. Dow Chemical closed its Midland facility in June 1982, while other producers with several plants may follow suit to rationalize production among their other facilities. Alcoa's revamped 398-tpd facility (based on caustic), slated to reopen in the spring of 1982, is still closed because of the downturn in the aluminum industry.

Availability: 1982, market; 1981, market; 1980, market; 1979, tight to very tight; 1978, market.

Pricing: 1982, $145/ton, f.o.b. works, freight equalized; 1981, $145/ton; 1980, $145/ton; 1979, $135-$150/ton; 1978, $135-$145/ton.

FIGURE 2: **Projected U.S. price increases for major chemicals in 1983**



Forecast: Chlorine's list price has been meaningless since early in 1981, with actual selling prices ranging between $80-$110/ton, considerably different from the list price. Most chlorine tonnage apparently moves at about the $100/ton level. Over the last two years there have been several attempts by various suppliers to boost the off-list price—three in 1981 and two this past summer. The third try in 1982 was lead by Olin, which instituted a $20/ton hike effective in early September for spot sales. Four more producers subsequently announced a similar increase. If this boost holds, the gap between list price and off-list price may be closed sometime next year, assuming that chlorine demand begins to turn around by the first quarter of 1983. However, there is considerable resistance by chlorine consumers at this time to accept the increase, which may have to be reduced by $10/ton.

Although over the long term, chlorine usage by pulp mills will decrease gradually—under pressure of continued ClO_2 substitution—demand in 1983 is expected to return to the 1981 consumption level (1.4 million tons).

Hydrogen peroxide

Uses: Hydrogen perodixe (H_2O_2) is traditionally used in the pulp and paper industry primarily as a bleaching agent for chemical and mechanical pulps. It is also employed in the deinking of recycled newsprint.

Demand: In 1981, the pulp and paper industry used an estimated 13,000 tons, about 12% of total consumption (107,000 tons). Peroxide's major use is as a chemical intermediate, consuming 25% to 30% of the market. Other applications include textiles, municipal water and waste treatment, industrial effluent treatment, and uranium mining.

Sources: In descending order of capacity, the four U.S. H_2O_2 producers are: E.I. duPont, FMC, Interox America, and PPG. FMC is expanding its Bayport, Texas, plant by 10,000 tpy, due onstream in 1984.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: 1982, 39.5¢/lb, 70% solution, f.o.b. producing point, freight equalized; 1981, 35.6¢-39.5¢/lb; 1980, 35.5¢-36.5¢/lb; 1979, 32.5¢/lb; 1978, 28¢/lb.

Forecast: Total apparent consumption in 1982 will only increase to 108,000 tons. Paper industry usage should reach 16,000 tons, a 23% jump over 1981. Over the long term, pulp mill demand should increase an average of 10%/year, and total peroxide demand 8%/year. The use of H_2O_2 in industrial waste treatment, a relatively new outlet, is expected to grow between 8% to 9%/year, and offset somewhat slumping uranium mining demand.

Kaolin clay

Uses: Kaolin clays are employed in a wide range of paper and board grades as both filler and coating pigments. Coating applications account for about 54% of industry usage.

Demand: An estimated 3 million tpy of kaolin is used by the paper industry, about 75% of total kaolin consumption. Usage in 1982 is expected to be down about 100,000 tons. Approximate usage by grades: Nos. 1 and 2, 24%; water-washed, 22%; Nos. 3 and 4, 16%; delaminated, 13%; high-brightness and air-float, 10% each; and other, 5%. The next-largest end use is by the ceramics industry (20%), with the remaining 5% used in paints, rubber, refractories, and the like.

Sources: Producers are listed in the P&P *Buyers Guide*

1982, p. 32, "Register of coating and filler pigments."

Availability: 1982, market; 1981, market; 1980, market; 1979, market to tight.

Pricing: Premium No. 1 coating: 1982, $142/ton, f.o.b. Ga.; 1981, $130/ton; 1980, $118/ton; 1979, $108/ton; 1978, $98/ton. Water-washed No. 1 coating: 1982, $99.5/ton (same basis); 1981, $91.50/ton; 1980, $84/ton; 1979, $76/ton; 1978, $61.5/ton. Dry-ground filler grade (same basis): 1982, $61/ton; 1981, $56/ton; 1980, $51/ton; 1979, $35-$44/ton; 1978, $30-$35/ton.

Forecast: Kaolin usage is down this year because of the drop in output of both paper and paperboard. By the end of July, production was down almost 6% (compared with last year's seven-month period). In 1983, the total demand for both uncoated and coated papers is expected to be up about 6.5%, thus bringing paper industry usage of kaolin back to the 1981 level.

Lime

Uses: The kraft mill operator requires a low-cost alkali to causticize the sodium carbonate in the green liquor. Lime, being the cheapest alkali available (between 2¢-3¢/lb), is therefore basic to the soda/lime route to free caustic. Kraft mills produce reburned lime on-site.

Demand: In 1981, the pulp and paper industry used about 990,000 tons of lime, about 5% of total lime consumption of 19.5 to 20 million tons. In 1982, demand and mill usage will be basically flat. The steel industry used 37% of the total, with other applications being sewage treatment, chemicals, and sugar refining.

Sources: The major merchant manufacturers, produced mainly from calcite ($CaCO_3$) or dolomite ($CaMgCO_{32}$) are Domtar Industries, Genstar (formerly Flintkote), Kerr-McGee, Marblehead Lime, Martin Marietta Chemicals, Mississippi Lime, Pfizer, Steetley Industries, and U.S. Gypsum. (Steetley pruchased the Tacoma, Wash., plant of Domtar early in 1981.)

Availability: 1982, market; 1981, market; 1980, market; 1979, tight in eastern U.S., market in West; 1978, market to tight.

Pricing: Quicklime: 1982, $57.80/ton, f.o.b. plant; 1981, $51.63/ton; 1980, $46.10/ton; 1979, $41.16/ton; 1978, $36.75/ton.

Forecast: Improvements in construction and steel markets in 1983 may bring demand back close to the level reported in 1979 (21 million tons). Lime prices should increase between 11% and 12% in 1983.

Polyvinyl alcohol

Uses: Polyvinyl alcohol (PVA) is employed by the paper industry mainly as a surface size for printing and writing papers and paperboard, and as a coating binder.

Demand: In 1981, paper industry usage of PVA was between 10.5 and 11 million lb, about 8% of the total merchant demand of about 136 million lb. Production last year, excluding that required in the manufacture of polyvinyl butyral (PVB), was 144.5 million lb. In 1982, demand by paper and board mills is expected to decrease to between 9 to 10 million lb, while total consumption will be between 115 and 120 million lb. Imports in 1981 reached 24 million lb, and at the end of July 1982 were approaching an annual rate of 21.5 million lb. PVA's largest end use is by the textile industry (about 50% of total demand), followed by adhesives (25%) and emulsifiers (12%).

Sources: In descending order of capacity, the three U.S. producers of PVA, derived from the hydrolysis of polyvinyl acetate, are: E.I. duPont, Air Products & Chemicals, and Monsanto. Monsanto produces only partially hydrolyzed PVA; Air Products & Chemicals makes both fully and partially hydrolyzed product. DuPont's 50% expansion of its Laporte, Texas, plant will allow the manufacture of partially hydrolyzed grade when the project is completed in 1984.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: 1982, $1.05/lb, delivered basis; 1981, $1.00-$1.05/lb; 1980, 86.5¢-91.5¢/lb; 1979, 77.5¢/lb; 1978, 69.5¢/lb.

Forecast: PVA demand by the paper industry should grow around 3% to 4% in 1983. However, growth in overall demand is uncertain, but should increase 2.5%/year conservatively and could grow 6.5%/year in a strong economy.

Saltcake

Uses: Saltcake (sodium sulfate) is the main source of makeup sodium and sulfur values in kraft pulp mills.

Demand: In 1981, kraft pulp mills used an estimated 612,000 tons of saltcake, about 48.5% of the total consumption of 1.3 million tons. Mill usage in 1982 is expected to be slightly less. Other end uses include: detergent industry, 39%; and glass manufacture, 12.5%.

Sources: Sodium sulfate is produced from both natural deposits or as a byproduct in the manufacture of rayon, sodium bichromate, and hydrochloric acid. Until this year, natural sulfate capacity was about 52% of the total, but this dropped to 45.5% in 1982 when Kerr-McGee closed its Trona, Calif., facility. Major producers of natural saltcake include: Great Salt Lake, Kerr-McGee, and Ozark-Mahoning, while the major synthetic producers are: Allied, Akzona, Avtex, Climax Chemical, Diamond Shamrock, Koppers, and Morton. In 1981, imports from Canada were about 16% ahead of 1980, and a similar increase should occur in 1982.

Availability: 1982, market; 1981, market; 1980, tight to market; 1979, market to tight; 1978, market.

Pricing: 1982, $79-$80/ton, f.o.b. plant; 1981, $68-$79/ton; 1980, $60-$68/ton; 1979, $47-$52/ton; 1978, $35-$45/ton. Prices are regional, being slightly higher on the West Coast.

Forecast: Mill demand should increase if operating rates begin to rise again in 1983. However, the long-term prospects for pulp mill saltcake consumption depends on the extent of chlorine-dioxide substitution in the first bleaching stage. The effluent from ClO_2 generators contains sodium and sulfur values that can be used in place of purchased saltcake. An improved economy in 1983 could result in a saltcake price boost of about 10%. Ozark is involved in a two-year expansion program that will increase capacity at its Seagraves, Texas, plant by 50%.

Sodium chlorate

Uses: The major use of sodium chlorate is for on-site generation of chlorine dioxide (ClO_2).

Demand: In 1981, pulp mills used an estimated 283,000 tons of Na_2ClO_3, about 82% of total apparent consumption of 345,000 tons. Mill demand should increase slightly in 1982 to about 290,000 tons. Other uses are: chlorates (7%), uranium processing (5%), agriculture

(4%), and miscellaneous applications (25%).

Sources: The major producers of sodium chlorate—derived from electrolysis of an acidified sodium chlorate solution—include ERCO Industries, Georgia-Pacific, Kerr-McGee, Occidental Chemical's Cooker Div., Olin, and Pennwalt. Smaller facilities are operated by Brunswick Chemical, Huron Chemicals, and Pacific Engineering. Canadian imports now account for about 22% of total chlorate demand.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, tight.

Pricing: 1982, $420/ton, f.o.b. works, freight equalized; 1981, $375/ton; 1980, $345-$375/ton; 1979, $335-$345/ton. In the first half of 1982, the list price was discounted by $45/ton, but on July 1 the discount was removed for contract customers. One producer lists its chlorate at $440/ton but is reportedly matching the lower price.

Forecast: Pennwalt expanded its Tacoma, Wash., plant earlier this year (by 50%), while Kerr-McGee's planned expansion at Hamilton, Miss., will increase its capacity there by 30% in mid-1983. The additional capacity may partially offset growing imports from Canada, although by mid-decade Canadian capacity will be close to 500,000 tpy.

Sodium hydrosulfite

Uses: Sodium hydrosulfite is used as a bleaching agent for mechanical and deinked pulp.

Demand: In 1981, the paper industry used an estimated 16,700 tons (excluding hydrosulfite produced on-site from Borol). Apparent consumption was close to 56,000 tons. The textile industry is the largest consumer of sodium hydrosulfite (used in vat dyeing) and accounts for about 40% of total demand. Other end uses include clay bleaching (20%), and miscellaneous.

Sources: There are now two sodium hydrosulfite producers left in the U.S., Olin and Virginia Chemicals, Virginia having acquired Royce Chemical in late 1981. Virginia recently announced that it would close the Royce plant permanently. Borol solution is produced by Morton Thiokol's Ventron Div.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: 1982, 60¢/lb (proprietary blends), f.o.b. producing point; 1981, 55¢-60¢/lb; 1980, 43.5¢-55¢/lb; 1979, 41.5¢-43.5¢/lb; 1978, 39.5¢-41.5¢/lb.

Forecast: Sodium hydrosulfite consumption in 1982 may be slightly higher than last year, despite the downturn in the newsprint field. Hydrosulfite produced via Borol should also be ahead of the estimated 8000 tons (100% basis) employed by the mills in 1981.

Starch

Uses: Starches are the workhorse binders for the coating mills, and are also used as surface sizes, internal additives, and as an adhesive for corrugated containers.

Demand: In 1981, total starch consumption was between 4.0 and 4.5 billion lb, with 3 billion lb used by the paper industry. In 1982, mill usage will drop to 2.8 billion lb, while total demand will be down to between 4.1 and 4.2 billion lb. Food, brewing, and textiles are other major end uses for starch.

Sources: Producers are listed in the P&P *Buyers Guide 1981*, pp. 32-43. About 90% of the starch used in the paper industry is corn starch.

Availability: Unmodified: 1982, market; 1981, market; 1980, market; 1979, market. Modified: 1982, market; 1981, tight to market; 1980, tight; 1979, tight to market.

Pricing: Unmodified: 1982, $11.50-$12.25/100 lb, bags, truckload, f.o.b. plant; 1981, $11.25-$14/100 lb; 1980, $9.50-$10.50/100 lb; 1979, $9-$10/100 lb; 1978, $8/100 lb. (For bulk prices deduct $1.25/100 lb.) Modified starch prices vary for each grade, but generally follow price trends of unmodified starch.

Forecast: Two consecutive record corn crops have resulted in reduced starch prices in 1982. The $11.50/100 lb price should remain in effect for the balance of the year. However, farm support legislation expected in 1983 will most likely result in a price boost of about 10%. Both starch and high-fructose corn syrup (HFCS) supply is more than adequate to handle demand for the foreseeable future. A.E. Staley brought on a new plant in Tenn. Staley, which acquired the corn-processing operations of Anheuser-Busch in late 1981, increased its HFCS capacity by 1 billion lb (to 2.3 billion lb). Starch demand by the mills is expected to return in 1983 to the 1981 level (3 billion lb).

Styrene-butadiene latex

Uses: The bulk (about 90%) of the styrene-butadiene (SB) latex employed by the paper industry is used as a coating binder, with the remaining 10% used for paper saturation (such as wallpaper).

Demand: In 1981, about 220 million lb of SB latex were used by the paper industry, 38% of total latex consumption of 585 million lb. In 1982, usage should reach 225,000 lb. The major end use is in carpetbacking and integral foam. Other textile applications and adhesives account for the remaining 12%.

Sources: At least 80% of the estimated 915 million lb of annual capacity in the U.S. is shared by four major suppliers: Dow Chemical, Polysar, Reichhold, and General Tire (in descending order to nameplate capacity). Polysar acquired Arco Chemical and GAF latex operations, boosting them to the second spot.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: 1982, 71¢/lb; 1981, 65¢-71¢/lb; 1980, 59¢/lb; 1979, 53¢/lb; 1978, 40¢-43¢/lb.

Forecast: Feedstock costs are reduced compared to 1981, particularly styrene monomer, which has been discounted heavily in 1982. Both ethylene and benzene prices have also been depressed, although there have been recent attempts to raise the ethylene market price. Butadiene has been discounted as much as 6¢/lb. Decreased demand this year for lead-free gasoline has kept the price of benzene below $1.60/gal. As a result, there should be no change this year in the SB list price, however in 1983, prices will probably increase around 9%.

Sulfur

Uses: Sulfite pulp mills consume the bulk of the sulfur used by the pulp and paper industry. Some is also used directly in kraft pulp mills.

Demand: Pulp mills used less than 1% of the total sulfur consumed in 1981, requiring about 100,000 metric tons. (Total consumption was over 11.5 million tons.) The bulk of the sulfur purchased is for fertilizer and sulfuric acid production, the latter end use accounting for about 80% of total demand.

Sources: About 58% of elemental sulfur produced in the U.S. is via the Frasch route, with most of the balance coming from refineries and sour natural gas production. Major Frasch producers include Duval, Freeport, and Texasgulf. Major suppliers among the 60 or so firms recovering sulfur include Atlantic Richfield, Exxon, Getty, Mobil, Pursue Gas, Standard, Texaco, and Union Oil.

Availability: 1982, market; 1981, tight to market; 1980, tight; 1979, very tight; 1978, market to tight.

Pricing: 1982, $133.5/metric ton, crude, bright, f.o.b. Gulf Coast ports; 1981, $131.35-$138.73/metric ton; 1980, $103.31-$109.05/metric ton; 1979, $70.60/metric ton; 1978, $61.5/metric ton. U.S. recovered sulfur prices had been $15-$20/ton below Frasch levels, but are now about $8-$9/ton less. Reportedly, in some areas recovered sulfur prices are only $4/ton under the Frasch price. Currently, Canadian recovered sulfur is listed US$80-$85/metric ton f.o.b. Alberta producing points.

Forecast: The 1.3 million tons added to both Frasch and recovered sulfur capacity since 1980, coupled with poor fertilizer markets, has resulted in significant easing of supply. Some Frasch mines are running at low operating rates with no prospects of major improvements in the immediate future. A 10% boost in sulfur prices could occur if fertilizer markets improve in 1983.

Titanium dioxide

Uses: Both rutile and anatase grades of titanium dioxide (TiO_2) are employed by the fine paper and board mills, as a filler and in coating.

Demand: Demand for TiO_2 in 1982 will probably be down to between 165,000 to 170,000 tons. In 1981, the paper industry used about 183,000 tons out of an estimated total consumption of 814,500 tons. The paint industry now accounts for about 50% of total TiO_2 demand. Other end uses include plastics (10% to 12%), rubber, and ceramics.

Sources: Since NL Chemicals closed its TiO_2 plant in September, there are now five producers: American Cyanamid, E.I. duPont, Gulf & Western, Kerr-McGee, and SCM Glidden. About 75% of the TiO_2 produced in the U.S. is via the chlorine route, with the balance made by the sulfate process.

Availability: 1982, anatase/rutile, market; 1981, anatase/rutile, market; 1980, anatase/rutile, market; 1979, anatase/rutile, tight.

Pricing: 1982, anatase, 70¢/lb, delivered; rutile, 75¢/lb; 1981, anatase, 58¢-70¢/lb; rutile, 63¢-75¢/lb; 1980, anatase and rutile, 57¢/lb; 1979, anatase, 53¢/lb; rutile, 59¢/lb; 1978, anatase, 46¢/lb; rutile, 52¢/lb.

Forecast: DuPont has announced it will increase capacity to produce paper-grade rutile slurry at its Edgemoor, Del., plant by 70% by mid-1983. The plant's nameplate capacity of 110,000 tpy will remain unchanged.

Other major chemicals

Alum: Demand for alum has been off slightly in 1982 and prices have held steady for more than a year. Liquid alum is still selling at $133/ton in the North, $148.55/ton in the Northeast (New England), and $126/ton in the South. No increases are expected until next year, when an 8% to 10% boost may come about.

Casein: Since February 1982, the list price of the industrial casein has remained steady at $1.36/lb. Some price softening is expected by the end of the year.

Polyethylene: One of the few low-density polyethylene resin grades that has not been subject to severe discounting in 1982, extrusion-coating grade, is still listing at 45¢/lb, unchanged from the third quarter of 1981. If the reported turnaround in precursor ethylene prices continues, a 5% to 6% price hike could occur in 1983.

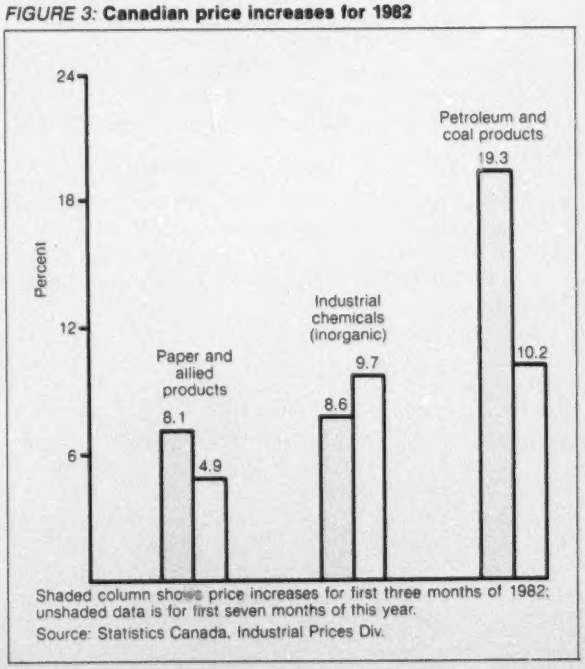
Polyvinyl acetate: Under the pressure of reduced monomer (VAM) prices, polyvinyl acetate prices are being discounted between 15% to 20% off the posted list price of 34¢/lb. Copolymer PVA_C has been selling for as low as 28¢/lb. Improvement in demand (down about 15% for the first seven months in 1982) and selling price is not anticipated until late in the year. A 10% price hike is expected for 1983.

Rosin sizes: Under pressure from decreased demand, bulk rosin prices were reduced $1.50/100 lb at the beginning of July. Seventy-percent pale material is now selling for $39.30/100 lb, f.o.b. southern producing points.

Soda ash: Decreased domestic demand for soda ash (Na_2CO_3), against a background of growing overcapacity, has resulted in two price decreases in 1982. At the end of June, natural trona prices decreased $2/ton to $90/ton, f.o.b. Green River. A similar decrease was instituted at the beginning of September, bringing the price of natural Na_2CO_3 tag to $88/ton. The $4/ton decrease was reportedly matched by Allied, the sole synthetic ash producer, bringing its f.o.b. Syracuse, N.Y., tag to $128/ton.

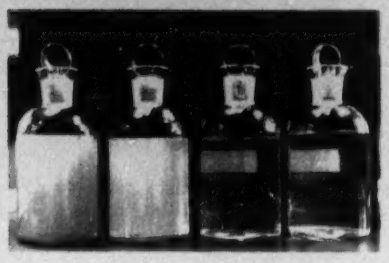
Wet-strength resins: The list price of most petrochemical feedstocks have been discounted substantially throughout most of 1982. However, the major raw materials for wet-strength resins—particularly polyamide-epichlorohydrin (PEC) and urea-formaldehyde (UF)—have continued to rise in price. PEC (12.5% solids) prices went up 8% on July 1, rising to $23.45/100 lb ($1.88/lb on a dry basis). UF prices had been boosted a month earlier (also by 8%), the 35%-solids grade going to $20/100 lb, while 25% UF was raised to $14.30/100 lb. In both cases, the dry-weight price is 57¢/lb. Melamine-formaldehyde (MF) wet-strength resin is currently selling for about $1/lb on a dry basis. A similar increase for wet-strength resins is expected for 1982. □

FIGURE 3: **Canadian price increases for 1982**



Shaded column shows price increases for first three months of 1982; unshaded data is for first seven months of this year.

Source: Statistics Canada, Industrial Prices Div.



Canadian survey

☐ Mill downtime has lowered demand for chemicals in 1982 across Canada. Chemical demand by the industry was also down in 1981, primarily because strikes idled almost 1,000,000 tons of pulp and papermaking capacity during the summer.

The results of the recession this year on price increases has been rather unusual. Although lists have gone up on some of the large-volume chemicals (see chemical profiles below), the year-to-year increase in the selling price index for industrial chemicals in July (see Figure 3) was only about 55% of that reported in 1981 (see PULP & PAPER, Nov. 1981, page 59).

Energy costs continued to rise (see Figure 3), although not as sharply as last year. Natural gas prices are expected to increase almost 20% during 1983 (mainly as a result of government surcharges).

Price discounting, while not as severe in Canada as it was in the U.S., is still occurring, with chlorine and caustic affected the most. Although paper industry demand for chloralkali is down significantly, actual production could be ahead of last year, since the leading producer is running its two plants full out as a result of a rationalization program with its U.S. parent. Nevertheless, prices for both caustic and chlorine have been discounted as much as 10%.

Consumption of bleaching chemicals dropped 6.4% in 1981 and at least a further 3.5% decrease is predicted for 1982.

Hydrogen peroxide is one of the very few chemicals that is expected to experience increased consumption by mills in 1982, despite the general industry downturn. Sparked by Ontario Paper Co. Ltd.'s expansion, demand by eastern Canadian mills should reach the 4000-ton mark this year.

By mid-decade, mills east of the Ontario/Manitoba border could account for more than 80% of the peroxide employed by the industry. The expected average annual growth to mid-decade of almost 17%—twice the average rate over the 1977-1979 period—may result in a domestic source of H_2O_2. The federal government recently approved the establishment of a joint-venture firm—between Solvay SA of Belgium and Laporte Industries of the United Kingdom—joint owners of Interox—which is planning to build a storage and distribution terminal in Milton, Ont., and, when justified by market growth, to produce the peroxide at a Quebec site to be determined at a later date.

DEFINITIONS OF SURVEY AVAILABILITY TERMS:

Very tight—On allocation or demand significantly greater than supply

Tight—Demand slightly greater than supply

Market—Supply and demand in balance, or excess capacity available

Aluminum sulfate

Uses: Alum usage is split approximately 50:50 between the precipitation of rosin size and pitch control/water treatment applications.

Demand: In 1981, paper mills consumed 105,000 tons, or 59% of total alum consumption. In 1982, total mill usage is expected to decrease to 98,000 tons (57% of total demand), of which about 48,500 tons will be employed for sizing. Total alum consumption in 1981 was 177,500 tons (the same as in the previous year) and in 1982 is predicted to drop to the 172,500-ton level. Municipal waste and sewage treatment applications now account for betwen 30% and 32% of the total, the balance going into pigments, cellulose insulation, and other miscellaneous end uses.

Sources: There are two major Canadian alum producers—Alcan Smelters & Chemicals and Allied Chemical Canada—and three smaller firms in western Canada, the largest (with two plants) being Inland Chemical, a CIL subsidiary.

Availability: 1982, market; 1981, market; 1980, market; 1979, market to tight.

Pricing: 1982, $131.54/ton, liquid (17% Al_2O_3), bulk, f.o.b. Valleyfield, Que.; 1981, $100.70-$119.75/ton; 1980, $86-$100.70/ton; 1979, $79-$86/ton.

Forecast: The price of alum increased once in 1982, in January. No further increase is anticipated until next year, when mill demand should begin to increase. Average growth for total mill usage for the next three years is estimated at 7%/year.

Caustic soda

Uses: Caustic soda (NaOH) is used in the extraction stages of kraft or sulfite bleach plants, for hypochlorite makeup and in sulfite pulping.

Demand: In 1981, pulp mills consumed about 990,000 tons of caustic (62% of total domestic demand), with 714,000 tons used in the bleach plant. An additional 276,000 tons were employed for pulping applications. In 1982, demand decreased to 935,000 tons (694,000 tons for bleaching end uses). The next-largest end uses are in the production of propylene oxide and alumina, which last year accounted for 7% and 6% respectively of total demand.

Sources: Caustic is a coproduct of chlorine production. The major producers are listed in the chlorine section.

Availability: 1982, tight to market; 1981, very tight to tight; 1980, very tight; 1979, tight; 1978, tight.

Pricing: 1982, $381-$435.45*/ton, 50% solution, bulk, f.o.b. works, freight equalized; 1981, $293-$381/ton; 1980, $195-$293/ton; 1979, $183-$195/ton; 1978, $175-$183/ton. (* Effective April 1; no further hikes expected in 1982.)

Forecast: Caustic prices are now almost on a par with those for soda ash (based on Na_2O equivalent), which will likely result in some sulfite mills probably replacing caustic with soda ash even though caustic is available.

Overall caustic demand by the pulp and paper industry is expected to increase about 2%/year to mid-decade, although usage for sulfite pulping could drop below the 190,000-ton level by 1985—from the 245,000 tons predicted for 1982.

Chlorine

Uses: Chlorine's major use by the pulp and paper industry is as a bleaching agent in kraft and sulfite pulp mills. A smaller use is for on-site hypochlorite makeup.

Demand: In 1982, the pulp and paper industry used about 531,000 tons of chlorine, down about 7% from the 571,500 tons consumed in 1981. The industry share of total chlorine demand has decreased from 43% in 1980 to 39% in 1981. The rapid growth in ethylene dichloride (EDC) production has resulted in this market growing to 40% of total demand.

Sources: Chlorine is produced along with caustic by the electrolytic reduction of brine. Major chloralkali producers include CIL, Canadian Occidental Petroleum, Dow Chemical Canada, FMC Chemicals, and PPG Industries, Stanchem Div.

Availability: 1982, market; 1981, market; 1980, market; 1979, tight; 1978, tight.

Pricing: 1982, $254-$281*/ton, bulk, f.o.b. works; 1981, $225-$254/ton; 1980, $195-$255/ton; 1979, $163-$195/ton; 1978, $145-$165/ton. (* Effective April 1.)

Forecast: Pulp mill chlorine usage will decrease over the next few years as chlorine dioxide use grows. However, demand will not drop as rapidly as originally predicted. Most mills are only replacing between 6% to 8% of their first-stage chlorine requirements, rather than the originally proposed 30% to 70%. In fact, only one mill is at the theoretical maximum, while around four mills are currently operating on a greater-than-25% replacement basis. Moreover, in the near future—assuming that pulp markets begin their recovery next year—chlorine consumption by the mills should increase about 3%/year to mid-decade.

Hydrogen peroxide

Uses: The pulp and paper industry employs hydrogen peroxide (H_2O_2) as a bleaching agent for mechanical and chemical pulps. It is also used in the bleach plant as a partial replacement for ClO_2.

Demand: In 1981, Canadian mills used an estimated 5700 tons of H_2O_2, about 69% of total peroxide consumption. In 1982, mill usage is predicted to reach 7500 tons, 75% of total demand. Other end uses include textiles (9.5%), water treatment (5.5%), and miscellaneous applications (16%).

Sources: All of the peroxide consumed in Canada is imported. The major importers are CIL and duPont, which bring in H_2O_2 from FMC and E.I. duPont, respectively. FMC and Interox America ship in some on a direct basis, while several distributors handle European H_2O_2.

Availability: 1982, market; 1981, market; 1980, market to tight; 1979, market; 1978, market.

Pricing: 1982, 52.5¢/lb, bulk, 70% solution, f.o.b. Toronto; 1981, 47.5¢-52.5¢/lb; 1980, 44¢-47.5¢/lb; 1979, 41¢-44¢/lb; 1978, 36¢-41¢/lb.

Forecast: Hydrogen peroxide prices, unchanged since July 1981, should finally increase about 10% next year. By mid-decade, consumption by mills could reach the 11,500-ton level, almost 80% of total demand.

Hydrosulfites, borohydride solution

Uses: Almost all newsprint mills bleach groundwood with hydrosulfite. An alternative to purchased sodium hydrosulfite (either unblended or proprietary blends), Borol is employed by many mills to generate sodium hydrosulfite on-site.

Demand: In 1981, the pulp and paper industry used an estimated 10,200 tons of merchant sodium hydrosulfite, and an additional 8000 tons of Borol (on a 12% active borohydride basis). Vat dyeing of cotton accounted for about 12% of the total.

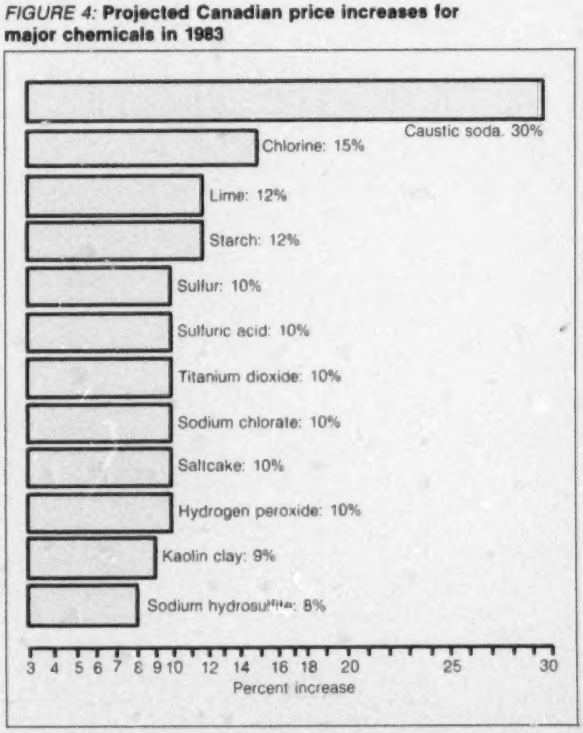
Sources: No hydrosulfite has been produced in Canada for several years. VirChem Canada imports blended hydrosulfites from its U.S. parent, Virginia Chemicals (a subsidiary of Celanese), while various distributors bring in product from Europe. Borol is shipped in exclusively by the Ventron Div. of Thiokol, which is merging with Morton-Norwich.

Availability: Hydrosulfite blends: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market. Borol: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: Blended: 1982, 69¢-71¢/lb, delivered, eastern Canada; 1981, $59¢-$64/lb; 1980, 51.4¢/lb; 1979, 50.5¢/lb. Nonblended: 1982, 61¢-71.5¢/lb; 1981, 66.4¢-71.5¢/lb; 1980, 56¢-66.4¢/lb; 1979, 47.5¢-56¢/lb.

Forecast: The recent price boost of sodium hydro (to 71¢/lb) was actually an exchange adjustment and no further price hikes are expected until 1983. Mill downtime in 1982 will reduce hydrosulfite purchases by about 1000 tons. However, demand should pick up again and grow, on an average, 8%/year to mid-decade. Borol usage should increase about 9% in 1982. From 1981 to 1985 the annual growth in Borol demand should average 17%.

FIGURE 4: **Projected Canadian price increases for major chemicals in 1983**



Kaolin

Uses: Kaolin is used by paper and paperboard mills as a filler and as a coating pigment with coating applications accounting for 56% to 57%.

Demand: In 1981, coating applications consumed an estimated 127,000 tons of kaolin clay, while an additional 96,000 tons were used as filler, representing about 87% of total kaolin demand. The inventory buildup that began in 1979, when more than 300,000 tons were imported, has apparently eased, since imports have decreased since that time. In 1981, 255,500 tons were imported (280,500 in 1980). In 1982, consumption is expected to drop to 121,000 tons and 93,000 tons respectively for coating and filler end uses.

Sources: U.S. suppliers are listed in P&P *Buyers Guide 1982*, "Register of coating and filler pigments," pp. 32-38. The balance of the imports are from English China Clays of the U.K., imported by Somavac of Trois-Rivières, Que., which slurries the product for resale.

Availability: 1982, market; 1981, market; 1980, market; 1979, market to tight.

Pricing: Water-washed No. 1 coating grade: 1982, $218/ton, f.o.b. Ga.; 1981, $215-$218/ton; 1980, $208-$215/ton; 1979, $194-$208/ton. Dry-ground, air-floated filler grade: 1982, $60/ton (same basis); 1981, $47-$60/ton; 1980, $43-$47/ton; 1979, $35-$43/ton.

Forecast: Coating end use is expected to increase its share slightly (to 57%) to rise to between 144,000 and 145,000 tons out of a total mill consumption of 253,000 tons.

Lime

Uses: Kraft mills purchase lime to supply supplementary calcium requirements.

Demand: In 1981, pulp mills used 216,500 tons of lime (10.8%) out of a total consumption of slightly more than 2 million tons. In 1982, lime usage is expected to be down by 10,000 tons. The largest lime consumers are the iron and steel mills, which last year accounted for more than 700,000 tons (34% of the total). Other lime end uses, in descending order of volume, include: chemicals, uranium recovery, nonferrous smelters, water and sewage treatment, and sugar refining.

Sources: There are about nine merchant lime producers in Canada. The three major firms (based on nameplate capacity) are Domtar, Steel Brothers of Canada, and BeachviLime, which has a captive steel company customer as well (Dofasco). Algoma Steel and Steel Co. of Canada also have large captive operations. Because of high transportation costs (which continue to escalate), most lime plants are generally located within a reasonable distance of their customers.

Availability: 1982, market; 1981, market; 1980, market; 1979, tight to market; 1978, market.

Pricing: Quicklime: 1982, $55-$59/ton, bulk, f.o.b. producing plant; 1981, $46-$55/ton; 1980, $40.98-$46/ton; 1979, $34.98/ton; 1978, $32.48-$39/98/ton.

Forecast: The percentage of total lime consumption accounted for by the pulp and paper industry is declining with time, particularly as more mills opt for oxygen enrichment in the lime kiln. However, actual lime purchases by the mills should increase about 2%/year to mid-decade. Overall lime market growth has also been declining, rising less than 1% in 1981, compared with 1.5% in 1980 and 4%/year in the 1977-1979 period. Exports have also been dropping off, since the bulk of shipments to the U.S. have been to the steel industry.

Saltcake

Uses: Saltcake is used by kraft pulp mills for sodium and sulfur makeup.

Demand: In 1981, pulp mills used 318,500 tons, about 81% of total sulfate demand (394,000). The slump in the market pulp area will reduce mill consumption in 1982 to about 305,000 tons. The next-largest end use, the detergent industry, accounts for 13% of demand.

Sources: Most sodium sulfate comes from the Glauber salt deposits in Alberta and Saskatchewan with byproduct sulfate capacity only 11% of the total. The major producers include Alberta Sulphate, Hudson's Bay Mining & Smelting's Francana Minerals Div., and Saskatchewan Minerals. The latter firm last year acquired the closed facility of Sybouts Sodium Sulfate and reopened it in May 1982. The two byproduct sulfate producers are Courtaulds and Ontario Paper, both in eastern Canada.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: 1982, $70-$75*/ton, bulk, saltcake, f.o.b. producing point; 1981, $55-$70/ton; 1980, $50-$55/ton; 1979, $50/ton; 1978, $45-$50/ton. (* Effective April 1.)

Forecast: The price of saltcake has remained steady since the spring, and no further change is expected in 1982. If pulp markets improve significantly, a 10% price boost could occur next year in the second or third quarter. Over the long term, there will be more effluent recycling from ClO_2 generators, thus reducing the amount of purchased saltcake required.

Sodium chlorate

Uses: Sodium chlorate's main use is in chlorine dioxide generators.

Demand: In 1981, pulp mills used an estimated 197,000 tons of sodium chlorate, 95% of total chlorate consumption (206,500 tons). The slowdown in pulp markets will reduce mill demand to about 202,000 tons in 1982. Uranium leaching, the only other significant end-use for chlorate, should require about 11,000 tons in 1982.

Sources: The Canadian merchant producers of sodium chlorate are Canadian Occidental, Erco Industries, KemaNobel (formerly QueNord Chemicals), and PPG Industries, Stanchem Div. BCM Technologies is building a plant near Windsor, Que., due on-stream late this year or early 1983. The three remaining captive producers are B.C. Chemicals, St. Anne Chemical, and Saskatoon Chemicals; Canso Chemicals and Huron Chemicals having closed their plants late last year.

Availability: 1982, market; 1981, market; 1980, market; 1979, market; 1978, tight.

Pricing: 1982, $410*/ton, bulk, f.o.b. works, freight equalized; 1981, $365/ton; 1980, $310-$330/ton; 1979, $281-$310/ton; 1978, $250-$281/ton. (* PPG lists at $420/ton.)

Forecast: Pulp mill demand in 1982 is not expected to increase more than 5%, but chlorate consumption in that sector should grow about 8%/year to mid-decade. The two-tier list for sodium chlorate of $410-$420/ton should remain in force until at least year-end. In 1983, prices are expected to increase about 11%.

Starch

Uses: Most of the starch (80%) used is applied at the size press; some is employed with styrene-butadiene latex systems for coating. Wet end applications account for a relatively small quantity.

Demand: In 1981, the paper industry used an estimated 66,000 tons of starch, about 19% of total consumption, and this should increase about 1000 tons in 1982. The production of corn sweeteners accounted for about 54% of total demand in 1981. Other end uses include food starches, corrugated and other adhesives, ore flotation, and miscellaneous applications.

Sources: The bulk of the starch used by the paper industry is derived from corn. Major corn starch producers include Canada Starch, Nacan Products, St. Lawrence Starch, and Zymaize. International Grain Products is a smaller producer of corn starch and also supplies wheat starch.

Availability: Unmodified: 1982, market; 1981, market; 1980, market; 1979, market. Modified: 1982, market; 1981, market; 1980, market; 1979, market.

Pricing: 1982, native pearl (unmodified), $20.70/100 lb, truckload, bags, f.o.b. Toronto/Montreal; 1981, $19.20-$20.70/100 lb; 1980, $16.45-$19.20/100 lb; 1979, $14.45-$16.45/100 lb; 1978, $12.60-$14.59/100 lb. Modified starch prices vary according to grade, and generally follow the price trend for unmodified starches.

Forecast: With another record U.S. corn crop forecast for 1982, coupled with a drop off in Canadian demand, no price hikes are anticipated for the balance of 1982. A highly competitive marketplace has led to some discounting for larger-volume consumers. Annual growth in demand by the mills is expected to average about 4% to mid-decade.

Sulfur

Uses: Sulfite pulp mills that do not purchase liquid sulfur dioxide burn sulfur to produce gaseous SO_2 for sulfite and bisulfite cooking liquor makeup. ClO_2 generation and other uses in the bleach plant consume small amounts.

Demand: In 1981, an estimated 257,000 metric tons of sulfur were purchased by the Canadian pulp and paper industry, accounting for 30% of total consumption (about 853,000 metric tons). In 1982, the industry's usage is expected to decrease to about 235,000 tons, 28.5% of total demand. The largest end use for sulfur is sulfuric acid (63.5%), followed by carbon disulfide production, rubber vulcanization, and other miscellaneous applications.

Sources: All sulfur produced in Canada is recovered, either from sour-gas operations or petroleum refineries. Major producers include Amoco, Canadian Occidental, Canterra Energy (formerly Acquitaine Canada and Texasgulf), Chevron Standard, Dome Petroleum (formerly Hudson's Bay Oil & Gas), Petrogas Processing, Shell, and Westcoast Transmission.

Availability: 1982, market; 1981, tight to market; 1980, tight, 1979, tight.

Pricing: 1982, crushed, slate or molten, $75-$85/metric ton, f.o.b. producing point; 1981, $59.98-$74.48/ton; 1980, $32.76-$59.98/ton; 1979, $24.82-$29.79/ton. (Note: prices are in Canadian dollars.)

Forecast: Sulfur prices, which increased about 12% in 1982, should rise a similar amount during 1983. Sulfur consumption by the pulp and paper industry is on a downward trend, and by 1985, pulp mill usage will be less than 196,000 metric tons. (Prior to 1975, when sulfur usage began to decrease, the mills consumed upwards of 300,000 metric tpy.)

Sulfuric acid

Uses: The major use of sulfuric acid (H_2SO_4) is in the kraft pulp mill for chlorine dioxide generation.

Demand: In 1981, 268,000 tons of sulfuric acid were consumed by Canadian pulp mills out of a total of almost 4 million tons. The production of phosphoric acid is the major use and accounted for about 60% of the total in 1981. Pulp mill use in 1982 is expected to decrease to 241,000 tons. Other end uses include agricultural chemicals, petroleum refining, soaps and detergents, cellulose film, and viscose rayon.

Sources: Major merchant producers include Allied Chemical, Border Chemical, Cominco, Inco Metals, Inland Chemicals, and Kidd Creek Mines (formerly Texasgulf Canada). CIL, the largest acid supplier in North America, sold its Copper Cliff, Ont., operation to Inco in March 1981. In addition to the Inco-produced acid, CIL markets Kidd Creek's output as well as the acid not required captively by Falconbridge Nickel. Esso Chemical Canada and Western Cooperative Fertilizers are the major acid producers for captive purposes.

Availability: 1982, market; 1981, tight to market; 1980, market to tight; 1979, tight to market; 1978, very tight.

Pricing: 1982, 66° Baume, $84.55/ton, bulk, f.o.b. producing points, eastern Canada; 1981, $69.31-$84.55/ton; 1980, $60.87-$69/31/ton; 1979, $52.40-$60.87/ton.

Forecast: The 10% drop in pulp mill acid consumption in 1982 followed an 8.5% decrease in 1981 (largely due to the summer strike on the West Coast). However, mill demand is expected to increase, on an average, 6%/year to mid-decade. Prices went up twice in 1981, the second boost (of $6.76/ton) occurred in December. A 10% hike is likely in 1983.

Titanium dioxide

Uses: About 90% of the anatase TiO_2 used by the paper industry is employed for fine paper applications, with the balance used in paperboard.

Demand: Strikes at fine paper mills in the 1980-1981 period reduced TiO_2 demand for paper coating in 1981 to 7200 tons (from about 8200 tons in the previous year) out of a total titanium dioxide demand of 73,000 tons. In 1982, mill usage should reach 7700 tons. The paint industry accounts for between 58% to 59% to total usage, while plastics applications take about 16%.

Sources: There are two domestic producers—NL Chem Canada (formerly Canadian Titanium Pigments) and Tioxide of Canada, with a combined capacity of 79,000 tpy.

Availability: 1982, untreated anatase, market; 1981, market; 1980, market; 1979, market; 1978, market.

Pricing: 1982, $74.50-$80/100 lb, untreated anatase, delivered bags; 1981, $69-$74.50/100 lb; 1980, $59-$69/100 lb; 1979, $48.50-$59/100 lb. (Bulk slurry carries a 50¢/100 lb premium.)

Forecast: TiO_2 prices have not changed since January 18, 1982, and are expected to hold steady until year end. If demand improves in 1983, a 10% price hike is likely. Although total domestic demand is expected to grow at slightly less than 5%/year to mid-decade, mill usage should increase 11% to 12%/year to 1985. □

Silvichemical review: wood-based chemical production in U.S., Canada

Kraft mill byproducts have become increasingly important to the pulp and paper industry; production trends and values are detailed

By KENNETH E. SMITH, Executive Editor

☐ Numerous chemicals and other byproducts are derived from tree components and from spent pulping liquors. These byproducts, termed "silvichemicals," have become an increasingly profitable and diversified industry in recent years.

There are three primary sources of silvichemicals:

1. Sulfite and sulfate pulping processes
2. Pine stumps and pine tree tappings
3. Wood and bark.

Of these three, the chemical pulping processes provide the bulk of silvichemical products. During chemical pulping, 50% or more of the wood is dissolved by the inorganic cooking chemicals. The resulting complex mixture of lignosulfonate salts and wood sugars present in the waste or spent liquor is a rich source of chemical products. Pine stumps and pine tree tappings yield a group of byproducts termed "naval stores," which includes rosin, turpentine, and pine oils. Wood, woodchips, and bark can be distilled or extracted to produce a variety of specialty chemicals.

Silvichemical products can be classified under the following categories:

1. Tall oil products
2. Rosin products
3. Turpentine
4. Lignosulfonates
5. Wood and bark chemical products.

Tall oil and turpentine are the major byproducts of the sulfate (kraft) softwood pulping process. Rosin is distilled from pine tree tappings (gum rosin), from pine stumps (wood rosin), and from tall oil (tall oil rosin). Lignosulfonates, the metallic salts derived from the lignin in wood, were formerly produced only from spent sulfite liquor, but are now being made from sulfate black liquor as well. Wood and bark products range from charcoal to ethanol.

The three major product groups (naval stores, sulfate mill products, and sulfite mill products) shifted significantly in importance between 1963 and 1980. The combined annual value of sulfate mill products and sulfite mill products (at constant dollars) increased by 83% during this 17-year period, while the annual value of naval stores decreased by 55%. Actually, the decline in the annual value of naval stores has been even greater than this, since the second-largest revenue earner in that group, pine oil, is now made primarily from sulfate turpentine.

Tall oil products

Tall oil is present in the black liquor produced during sulfate (kraft) pulping of softwoods in the form of a crude soap. This soap, approximately 50% resin acids and fatty acids, is skimmed from the surface of the black liquor and boiled with sulfuric acid to remove the residual black liquor and sodium salts, as well as lignin and other impurities.

The crude tall oil thus recovered is about 95% rosin and fatty acids and 5% sterols, alcohols, and other materials. The rosin and fatty acids may then be separated through fractionation; or the crude tall oil may be acid-refined, which improves the color and odor but does not separate the components.

Production of crude tall oil increased at an average annual rate of 4.3% between 1963-1981, reaching 1761 million lb, or 880,500 short tons, in 1981. Production of sulfate pulp increased at an annual rate of 9.5% during the same period. The difference between the increase in tall oil production compared with the increase of sulfate pulp production reflects several factors in the industry including: increased pulping of hardwood; increased use of sawmill residuals and byproduct chips; use of continuous rather than batch digesters; and increased cutting of younger, plantation-grown pine trees.

Improved recovery techniques and increased sulfate pulping of extractive-rich Southern pines have begun to reverse the decline in tall oil yields, however. In 1980, about 76% of the U.S. softwood sulfate paper-grade pulp capacity (30.7 million tpy) was based in the South. Between 1975 and 1981, production of crude tall oil rose at an average annual rate of 7.2%, from 1228 million lb in 1975 to 1761 million lb in 1981.

Trends in the production of the three major tall oil fractions (rosin, fatty acids, and distilled tall oil, includ-

ing acid-refined tall oil) are shown in Table 1. Tall oil fatty acids (TOFA) in recent years have experienced the greatest revenue increase of the three fractions. In 1980, they had an annual wholesale value of $102 million f.o.b. mill, or about $6 million less than the annual value of tall oil rosin that year. In 1961, the annual value of tall oil rosin production was twice that of TOFA.

Currently, the major tall oil fractionators in the U.S. are Arizona Chemicals, Hercules Inc., Union Camp Corp., Reichhold Chemicals Inc., Sylvachem Corp., Westvaco Corp., Monsanto-Emery, and Georgia-Pacific Corp. During the late 1950s and early 1960s, surface coatings were the largest single end use for domestic tall oil fatty acids. However, as the following breakdown shows, intermediate chemicals now account for about half the total U.S. TOFA consumption:

Major uses of tall oil fatty acids in U.S.
(% of total consumption)

Use	1971	1980
Intermediate chemicals	36.8	49.1
Protective coatings	30.0	21.2
Soaps and detergents	13.3	7.1
Ore flotation	6.1	3.7
Miscellaneous	13.8	18.9

Source: Pulp Chemicals Assn.

Dimer acids used in polyamide resins for ink, adhesive, and special coating applications are the most important intermediate chemicals, accounting for nearly two-thirds of the TOFA consumption in this category. Other chemicals under this heading are:

- Epoxidized esters used as a plasticizer/stabilizer system for PVC resins
- C-21 diacid surfactants made by reacting acrylic acid with the linoleic content of TOFA and then removing the unreacted oleic acid.
- Oleic, linoleic, and conjugated linoleic acids produced from low-rosin TOFA via solvent crystallization and subsequent treatment
- TOFA amido amines for flotation.

TABLE 1: **Production of crude tall oil and tall oil fractions in U.S., 1963-1981**

(million lb)

Year	Crude tall oil*	Tall oil rosin	Tall oil fatty acids**	Distilled tall oil*
1963	990	275	239	82
1964	1104	305	264	81
1965	1145	326	298	84
1966	1242	364	337	108
1967	1211	354	333	104
1968	1239	371	339	99
1969	1284	412	371	98
1970	1252	416	400	99
1971	1268	419	407	92
1972	1293	437	429	92
1973	1329	443	412	82
1974	1213	366	363	82
1975	1228	342	293	75
1976	1484	410	374	85
1977	1518	406	359	103
1978	1616	424	388	115
1979	1697	464	416	113
1980	1754	448	407	103
1981	1761	444	407	109

*Source: Pulp chemicals Assn; distilled tall oil data include acid-refined tall oil
**Source: Chemical Economic Handbook, SRI International

TABLE 2: **Production of rosin in U.S., 1963-1981**

(million lb)

Year	Gum rosin	Steam-distilled wood rosin	Tall oil rosin	Total rosin
1963	239	571	275	1085
1964	203	539	305	1047
1965	187	561	326	1074
1966	141	513	364	1018
1967	116	502	354	972
1968	88	499	371	958
1969	61	432	412	905
1970	45	400	416	861
1971	48	381	419	848
1972	46	364	437	847
1973	39	342	443	824
1974	28	284	366	678
1975	37	186	342	565
1976	31	265	410	706
1977	26	251	406	678
1978	18	240	422	682
1979	14	232	464	710
1980	12	230[e]	418	660
1981	10	230[e]	450	690

Sources: Crop reporting board, USDA, Pulp Chemicals Assn. Production data for gum rosin and steam-distilled wood rosin refer to crop year, April 1 to March 31.
e = estimated.

Rosin

Gum and wood rosin (naval stores rosin) are distilled from pine oleoresin—gum rosin from the sap of living trees, and wood rosin from the oleoresin extracted from dead stumps with solvents, then steam-distilled. Tall oil rosin is fractionated from crude tall oil.

The gum rosin and turpentine industry in the U.S. has practically vanished. The remaining activity is almost entirely in south Georgia. The U.S. is a net importer of both gum rosin and gum turpentine. Gross imports of gum turpentine during the April 1980-March 1981 crop season totaled 534,500 gal, a 49% increase from the previous season. Gross imports of gum rosin during the same period totaled 14.7 million lb, down 30% from the previous season. In 1980, the total market value of U.S.-produced gum rosin and gum turpentine was only about $5 million.

Only two U.S. companies, Hercules and Reichhold, still manufacture steam-distilled wood rosin and turpentine. The wood rosin business in the U.S. is based on the extraction of rosin and terpenes from aged pine stumps which are primarily from cuttings of virgin forests in the Southeast. Aged pine stumps are required because they are high (20% to 25%) in extractable material. In recent years, these aged stumps have become more scarce, hence the decline in the wood naval stores industry.

Hercules recently has begun treating the root collars of relatively young trees with "Pinex" reagent (probably a herbicide such as Paraquat) prior to harvesting. Studies have shown that the extractives content of pine stumps cut two years after the treatment is significantly higher than untreated trees. Commerical application of the Pinex program was begun in the fall of 1979, and the first stumps will be harvested and processed in 1982.

The output of tall oil rosin exceeded that of naval

stores rosin for the first time in 1972, and reached a level of 444 million lb (222,000 short tons) in 1981 (see Table 2). Between 1963 and 1981, the share of tall oil rosin in total U.S. rosin production increased from 25% to 65%. Tall oil will probably account for nearly 90% of all rosin output by 1990 unless the Pinex process causes a major resurgence in the wood rosin industry.

Rosin consumption in the U.S. declined an average of 3%/year between 1970 and 1980. Total U.S. consumption in 1970 was 760 million lb, compared with 554 million lb in 1980. Significant decreases in rosin used for sizing paper and in rubber for tires have led to this decline. Exports have also declined, by 3.9%/year, from 256 million lb in 1970 to 179 million lb in 1980.

The following table is a breakdown of major uses:

Major uses of rosin in U.S.
(% of total)

Use	1977	1980
Rubber and chemicals	35.2	33.2
Paper sizing	33.5	33.1
Ester gums, synthetic resins	22.7	25.2
Paints, varnishes, lacquers	2.2	2.0
Other uses	6.7	6.5

Source: Pulp Chemicals Assn.

Printing inks appear to be the major potential growth area for increased rosin use, in the form of variously modified rosin esters and in resinates.

Sulfate turpentine

While total turpentine production in the U.S. declined 22% between 1963 and 1981, the production of sulfate turpentine increased 24% in that period, and in 1981 accounted for 89% of U.S. turpentine production (Table 3).

Sulfate turpentine is recovered from the condensate of kraft softwood digester relief gases. Gum and wood turpentine are distilled in the same manner as naval stores rosin, turpentine being the volatile part of the gum, and rosin the nonvolatile residue. Since 1963, the major use for turpentine has changed from its traditional one as a solvent for oil-base paints, to its primary use as a raw material in the production of various chemicals. Major uses of turpentine in the U.S. are indicated below, expressed as percent of total turpentine output in 1981:

Major uses of turpentine in U.S.
(% of total)

Use	1981
Synthesis of pine oil	48
Manufacture of terpene resins	16
Chlorinated terpene insecticides	15
Flavors and fragrances	10
Other	11

The major use of turpentine is currently in the synthesis of pine oil. More than 80% of the pine oil produced today is synthetic. The rest is "natural pine oil" obtained from fractionation of pine stumpwood extractives.

The increased demand for turpentine resulting from the development of new uses has made for a steady increase in price, further aggravated by a decrease in supply. Table 4 summarizes U.S. naval stores and sulfate mill silvichemicals production between 1978-81.

Canadian naval stores

Canada is a relatively small producer of naval stores at present. In 1980, Canadian crude tall oil (CTO) production totalled 84,000 tons, and Canadian sulfate turpentine production was 3.2 million gal.

There are two distinct geographical regions in Canada producing naval stores: Western Canada, consisting of interior kraft mills in British Columbia and Alberta; and Eastern Canada, particularly mills in the lakehead region of Ontario. Of the 12 mills in the western area with sulfate soap collection potential, only eight were collecting soap in 1980, and only two were producing CTO. In Eastern Canada, eight of nine mills with collection po-

TABLE 3: **Production of turpentine in U.S., 1963-1981**

(million gal)

Year	Gum	Steam-distilled wood	Sulfate*	Total
1963	7.03	7.87	18.78	33.7
1964	5.98	7.87	20.02	33.9
1965	5.57	8.43	21.03	35.0
1966	4.21	7.73	21.34	33.3
1967	3.39	7.02	20.99	31.4
1968	2.52	6.43	23.66	32.6
1969	1.75	5.14	23.98	30.9
1970	1.29	4.73	22.77	28.8
1971	1.42	4.27	22.75	28.4
1972	1.33	3.77	23.21	28.3
1973	1.07	3.44	22.02	26.5
1974	0.78	3.11	20.46	24.4
1975	1.03	2.07	19.27	22.4
1976	0.87	2.99	20.26	24.1
1977	0.73	2.62	20.30	23.6
1978	0.52	2.37	22.07	25.0
1979	0.37	2.44	23.45	26.3
1980	0.34	2.61	24.98	27.9
1981	0.31	2.61e	23.31	26.2

*Data refer to refined sulfate turpentine, derived from crude turpentine data by multiplying by 0.8
Sources: Crop Reporting Board, USDA, Pulp Chemicals Assn. Naval Stores Review, 1974 Yearbook
e = estimated

TABLE 4: **U.S. silvichemical production, 1979-1981**

(millions of units)

	Unit	1978	1981
Naval stores			
Gum rosin	lb	18	10
Steam-distilled rosin	lb	240	230
Gum turpentine	gal	0.52	0.31
Steam-distilled turpentine	gal	2.37	2.61
Sulfate mill products			
Crude tall oil	lb	1616	1761
Crude tall oil, used as such or sold	lb	138	160
Distilled tall oil[1]	lb	115	109
Tall oil rosin	lb	422	444
Tall oil fatty acids	lb	388	407
Sulfate turpentine	gal	22.07	23.31

1. Includes acid-refined tall oil
Source: Pulp Chemicals Assn.

tential are collecting soap, and five are producing CTO.

CTO recovery in 1980 averaged 44 lb/a.d. ton of pulp production at eastern mills and 35 lb/a.d. ton at western mills. The average CTO acid number is the east was 142, and the average in the west was 136. (Note: CTO acid number at mills in the U.S. South averages about 160.) The difference in CTO yield and quality between the two regions can be attributed to the varying species being pulped. Spruce is widely pulped in the west with pine, and gives very low CTO yields and quality (20 to 30 lb/a.d. ton yield, 143 calculated acid number). Also, sawmill chips are extensively pulped in the west, which leads to reduced byproducts yield.

Between 1979 and 1980, Canadian CTO production totals increased by nearly 13%. According to recent estimates, if all mills pulping soap-bearing woodchips were to implement soap collection at the present efficiency (estimated at 40%), CTO production would rise to 96,000 tpy by 1985. If soap collection efficiency were improved to an attainable 80%, CTO production could potentially reach 191,000 tpy. Thus, Canada remains the largest untapped source of tall oil in the western world.

Canada has only one operating CTO fractionation plant, a 19,000-tpy plant in Burlington, Ont., owned by Hercules Canada. In 1977, Canada exported 3700 tons of CTO to Japan and 37,000 tons to fractionation plants in the U.S. Exports increased in 1980 to 8300 tons to Japan and 41,900 tons to the U.S. Additionally, 30,700 tons of soap were shipped to the U.S. in 1980.

Soap shipments have since been discontinued because of prohibitively high transportation costs. Because Canadian CTO production exceeds domestic fractionation capacity by about 66,000 tpy, several companies have discussed building additional fractionation capacity there. However, it is likely that Canada will remain a net exporter of tall oil and an importer of refined tall oil products for several years.

In Western Canada, 12 of 20 kraft mills with sulfate turpentine collection potential have collecting equipment in place, but only eight of those mills are actively collecting turpentine.

In the east, eight of nine mills with collection potential are actively collecting turpentine. Turpentine yield in the east averaged 1.2 gal/a.d. ton in 1980, while average yield in the west was only 0.1 gal/a.d. ton. The low yield in the west is due to the predominant use of continuous digesters and sawmill chips for pulping.

The alpha-pinene and beta-pinene contents of the western turpentine from western interior mills is high in beta-phellandrene, a compound used to impart the menthol flavor to cigarettes. If an economical means were found to separate and recover this compound, western turpentine recovery efforts would probably be greatly increased. Also, it is estimated that if all Canadian mills pulping turpentine-bearing species and having turpentine collecton equipment were to collect turpentine, production would be increased to 4.1 million gal.

Other sulfate mill products

Dimethyl sulfide is produced by treating black liquor with sulfur at high temperature and pressure. Crown Zellerbach Corp. is currently producing about 20 million lb/year of dimethyl sulfide at its Bogalusa, La., mill. Some of the dimethyl sulfide is oxidized to dimethyl sulfoxide (DMSO), which has shown great promise as an industrial solvent and for some medical preparations, since it can diffuse through human or animal skin with ease. Initial restrictions on its use imposed by the Food & Drug Administration have now been removed. Expansion of existing plant capacity may, however, be stifled by the fact that dimethyl sulfide can easily be made by the petrochemical industry from methanol and hydrogen sulfide.

Westvaco produces **alkali lignin** ("sulfate lignin") at its North Charleston, S.C., mill by acidification of kraft black liquor. Sulfonation of this lignin yields a series of **lignosulfonates**. While these alkali-lignin-derived lignosulfonates make up only a small percentage of total lignosulfonate production, they have shown themselves to be very competitive with lignosulfonates from sulfite mills, since the degree of sulfonation of the alkali lignin can be selected to fit the end use.

These specialty compounds are used as dispersants, wetting agents, grinding aids, emulsifiers, coemulsifiers, stabilizers, antistripping agents, spray tank adjuvants, detergents, frothing aids, resin coreactants, sequestrants, air-entraining agents, retarders, fiber processing aids, leveling agents, hydrotropes, and other intermediates. Output of alkali lignin in 1980 was estimated at 60 million lb, with a value of about $8 million.

The total annual value of sulfate mill products in 1980 was estimated at $326 million, or slightly more than half of the annual value of byproducts produced by the three major groups in the U.S. that year (see Table 5). These figures are somewhat misleading, since pine oil made from sulfate turpentine is included in the naval stores category.

Lignosulfonates

Lignosulfonates are the main chemical byproduct of the sulfite pulping process. In 1980, the U.S. production of lignosulfonates amounted to 881 million lb, with a total value of $63.8 million. However, some of these lignosulfonates were made from sulfate lignin, as explained above. The average 1980 value for lignosulfonate production was $140/ton, which includes unmodified, low-profit commodity grades of whole spent sulfite liquor evaporated to 50% to 95% solids and sold mainly as binders for applications such as animal feed pellet manufacture, zinc production, and concrete mixing.

The uses of lignosulfonate specialty products cover a wide range, including emulsification, deflocculation, chelation, and adsorption. Probably the best prospects for growth (about 10%/year) in this area are oil-field chemicals, which are largely Na-based specialties. Lignosulfate mud thinners and dispersants are widely used in deep oilwell drilling, and currently sell for around $300/ton.

Normally, only sulfite mills using ammonia or calcium bases produce lignosulfonates because magnesium and sodium-base mills find it more economical to recover spent liquors. In the U.S., American Can Co., Crown Zellerbach Corp., Consolidated Papers Inc., Flambeau Paper Corp., Georgia-Pacific Corp., ITT Rayonier Inc., and Rhinelander Paper Co. are producers of specialty lignosulfonates. Crown Zellerbach has recently licensed its lignosulfonate line to ITT Rayonier, which will produce the chemicals at Hoquiam, Wash. Crown Zellerbach will phase out lignosulfonate production at its Lebanon, Ore., mill.

In Canada, Reed Paper Ltd. is the sole producer of specialty chemicals at its subsidiary, Lignosol Chemicals, in Quebec City, Que. The capacity of the Lignosol plant is currently being expanded from 110 to 240 million lb/year.

Other sulfite mill products

Vanillin is formed by the alkaline oxidation of lignosulfonates in desugared spent sulfite liquor. Production and sales of vanillin have increased faster than those of any other silvichemical in the U.S. during the past 17 years. The market for vanillin is expanding, not only for use as a fragrance and flavoring agent, but also as a valuable raw material for the chemical and pharmaceutical industries. Vanillin is currently the preferred raw material for the manufacture of l-dopa, a drug widely used in treating Parkinson's disease.

Monsanto's mill at Seattle, Wash., is producing about 15 million lb/year of vanillin, valued at $71 million, f.o.b. mill, using only a fraction of the spent pulping liquor produced at Georgia-Pacific's mill at Bellingham, Wash. ITT Rayonier brought a vanillin plant on-stream in 1979 at Hoquiam, Wash., with an initial capacity of 2 million lb/year.

In Canada, Ontario Paper Co. is producing 7 million lb/year of vanillin at its 240-tpd, Na-based sulfite mill in Thorold, Ont. As byproducts of this operation, the mill also produces aceto vanillone, vanillil, and oxalic acid.

Torula yeast (*Torulopis utilis* or *Candida utilis*) is grown in the pentose and hexose sugars present in spent sulfite liquor. This pleasant-tasting food yeast can average over 50% protein, and contains B-complex vitamins and all essential amino acids and numerous minerals necessary to good nutrition. It is used as a food additive to boost nutritional value and flavor and as a substitute for more expensive protein sources.

Production of torula yeast reached a peak of about 18 million lb/year in 1980. The product was priced at approximately $0.50/lb, f.o.b. mill, and annual sales revenue was about $75/ton of sulfite pulp from an average dry yeast yield of 150 lb/ton of pulp. At that time, two mills in the U.S., Rhinelander Paper, Rhinelander, Wis., and Boise Cascade, Salem, Ore., were producing the yeast. However, the Boise mill was closed in June 1982, leaving the Rhinelander mill as the sole U.S. producer of yeast from sulfite liquor, with a capacity of about 8 million lb/year.

Ethyl alcohol, or ethanol, is obtained by fermenting the sugars in spent sulfite liquor. Only one company in the U.S. (Georgia-Pacific) is currently making ethanol; the Bellingham, Wash., mill yields approximately 5.5 million gal/year of 190-proof alcohol, representing about 25 gal/ton of sulfite pulp. This alcohol is competitive in both quality and price with alcohol made from ethylene. Since there are presently nine sulfite mills of similar capacity to the Bellingham mill operating in the U.S., they could together produce some 50 million gal/year of 190-proof alcohol if they followed the example of Georgia-Pacific.

Ontario Paper Co., Thorold, Ont., is currently producing one million gal/year of ethanol from sulfite liquor, and is the only such producer in Canada.

Sonoco Products Co. is producing **acetic acid** at its NSSC pulp mill at Hartsville, S.C., by extracting the acidified spent pulping liquor with methyl ethyl ketone (MEK), which is then removed by distillation and recycled. Actually, both acetic and **formic acid** are obtained in this manner, but the latter is extracted with ethylene dichloride (EDC). Eight million lb of glacial acetic acid, worth about $1.9 million, are recovered annually. Formic acid is not sold at present.

The annual value of silvichemicals produced from spent sulfite liquors in the U.S. in 1980 is estimated at $166 million, or about 27% of the annual value of total U.S. production that year. This value may be low since it is based on unmodified lignosulfonates. □

TABLE 5: **Production and value of byproduct chemicals in U.S., 1980**

Product	Unit	Production (millions of units)	Average price[7] ($/unit)	Annual value ($ million)
Naval stores[1]				
Gum rosin	lb	12	0.35	4.2
Steam-distilled rosin	lb	230	0.30	69.0
Gum turpentine	gal	0.34	2.04	0.7
Steam-distilled turpentine	gal	2.61	1.80	4.7
Pine oil[6]	gal	9.64	3.80	36.6
Other turpenes	gal	2.95	1.80	5.3
Subtotal				120.5
Sulfate mill products:				
Crude tall oil	lb	1761	0.10	—[2]
Crude tall oil, used as such or sold	lb	118	0.10	11.8
Distilled tall oil[3]	lb	109	0.24	26.2
Tall oil rosin	lb	448	0.24	107.5
Tall oil fatty acids	lb	407	0.25	101.8
Sulfate turpentine	gal	24.98	1.45	36.2
Pitch	lb	580[5]	0.05[5]	29.0
Sulfate lignin	lb	60[5]	0.07[5]	8.4
Dimethyl sulfide	lb	18	0.37	4.2
Dimethyl sulfoxide	lb	2[5]	0.60[5]	1.2
Subtotal				326.3
Sulfite mill products:				
Lignosulfonate, Ca-base	lb	625	0.04	25.3
Lignosulfonate, Na-base	lb	99	0.17	16.9
Lignosulfonate, other[4]	lb	156	0.14	21.5
Lignosulfonate, total	lb	881	0.07	—[2]
Ethanol, 190-proof	gal	5.5	1.83	10.1
Vanillin	lb	17	4.75	80.8
Torula food yeast, dry	lb	18	0.50	9.0
Acetic acid, glacial[8]	lb	8	0.24	1.9
Subtotal				165.6
Total all categories				**612.4**

1. Naval stores data are for crop year, April 1 to March 3
2. Value accounted for under other headings
3. Includes acid-refined tall oil
4. Includes lignosulfonates from sulfate lignin
5. Estimated
6. Includes pine oil made from sulfate turpentine
7. Carload or wholesale price, f.o.b. mill
8. Made from NSSC spent pulping liquor

Industry makes significant gains in energy use during past 10 years

Fossil fuel, purchased power consumption per unit of output declined by more than 30% from 1972-81, but cost as percent of sales price doubled

By JOHN C.W. EVANS, Senior Editor

☐ During 1972-81, the pulp and paper industry achieved a 30.7% reduction in fossil fuel and purchased energy usage per ton of output compared with ten years earlier (Figure 1A), according to a report issued recently by the American Paper Institute. In "Patterns of fuel and energy consumption in the U.S. pulp and paper industry, 1972-1981," API explained that the 30% reduction was adjusted from the actual reported improvement of 24.9% to reflect operating changes between 1972-81 that affect efficiency (for example, capacity utilization rate, fuel mix, and energy used for environmental control).

Other major achievements in power usage and purchased fossil fuel and energy during this particular period include:

- Increased use of residue sources of fuel (spent pulping liquors, hogged wastewood, bark) and self-generated hydroelectric power was equivalent to 36 million bbl of oil (which equals about nine days of current U.S. oil imports).
- The industry's total oil consumption was down 43%, while purchased fossil fuels and energy fell nearly 15%. In the same period, output of pulp, paper, and paperboard increased more than 17%.

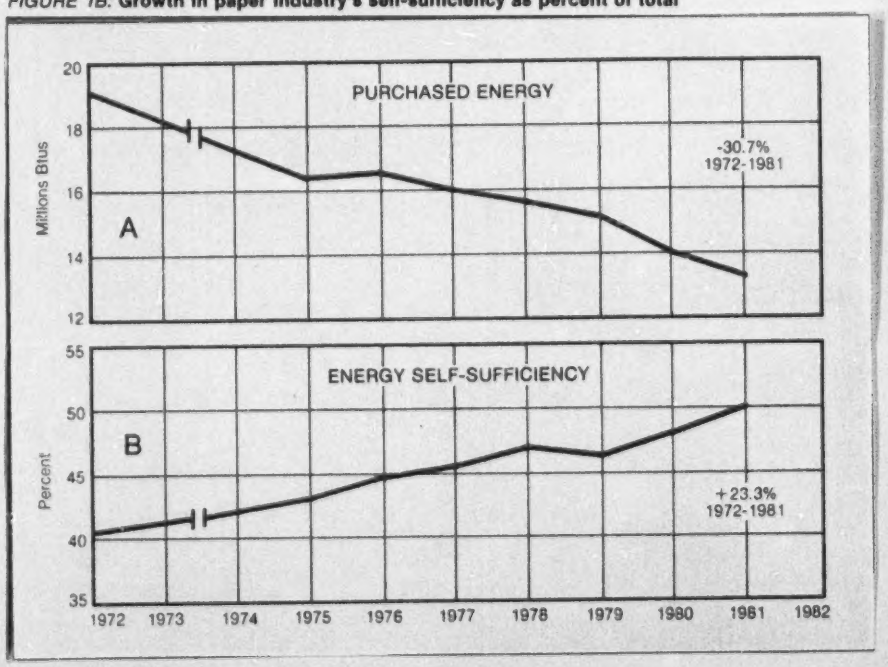
Hereby, the industry exceeded the Federal Energy Agency goal of a 23% reduction in the adjusted use of fossil fuel and purchased energy per ton of production.

According to the latest information (U.S. Dept. of Commerce, 1979), the U.S. pulp, paper, and paperboard industry is the third-largest user of fuel and energy of U.S. manufacturing industries, using 32% of all fuel oils and 6.8% of natural gas consumed in 1979. The paper industry was third in use of coal and purchased power.

The API report points out that the paper industry is the leading U.S. industry in producing electric power for its own use, including generating power from high-pressure steam and using resultant turbine low-pressure steam output as process steam (cogeneration). Some 37% of the industry's electricity is cogenerated (Figure 1B). According to the report, this is equivalent to more than five days of U.S. total oil imports at current rates.

Trends in consumption per ton of fossil fuel and power per ton of pulp, paper, and paperboard produced have de-

FIGURE 1A: **Fossil fuel and purchased energy consumption (adjusted)/ton**
FIGURE 1B: **Growth in paper industry's self-sufficiency as percent of total**



clined 25% since 1972 (Figure 2) despite a drop in capacity utilization in 1981 and increased energy use for lowering emissions. Thus, while increased production and prices gave a triple increase in total shipment value, purchased fuel and power costs were up sixfold. The cost of purchased fuel and power doubled in ten years, relative to the industry's average unit sales price, and cost per ton of product has risen due to their higher purchase price.

Fuel and energy sources

Consumption of 66.4 million tons of spent pulping liquor solids accounted for 37.6% of the total energy use by the industry in 1981, compared with consumption of 56.4 million tons of solids, or 33.6%, in 1972 (Figure 3).

Use of wood residues and bark as boiler fuel has increased from 6.6% of the paper industry's total energy consumption in 1972, to almost 12% in 1981. More than 30 million tons of wood residues and bark were consumed in 1981, compared with about 16 million tons in 1972.

Coal use has been almost level since 1972. An absolute decline occurred in the earlier part of the 1972-81 period, and slight increase was reported for 1980 and 1981. However, coal-fired boilers made up 24.0% of the total new boiler capacity sold to the paper industry in 1980, and 42% in 1981.

Use of natural gas and oil both decreased significantly from 1972 through 1974, with forced reduction in gas use due to the interruptible nature of supplies to industrial consumers, and allocations by suppliers to higher-priority end-users. Natural gas usage continued to decline through 1978, while oil rose in absolute terms. In 1978, with the Iranian crisis, the industry reversed its relative usage of gas and oil.

Use of purchased electricity increased slowly but significantly between 1972-81, from more than 27 billion kwh in 1972 to more than 41 billion kwh in 1981.

Boiler sales to the industry

Boiler sales to the pulp and paper industry for 1972-81 are discussed in the report's appendix. This study shows that although the number and capacity of boilers sold to the industry between 1972 and 1979 declined, sales in 1980 and 1981 increased over the 1979 levels.

The report shows that, in general, purchases of non-oil- and non-gas-burning boilers have increased dramatically since 1972 (Figure 4). Boilers based on these fuels represented 82% of sales of boiler capacity to the industry in 1972, and 59% of total sales in 1973. Purchases of non-oil- and non-gas-burning boilers increased to 96% of the total in 1980, before declining to 82% of the total in 1981. Although the largest increase in total capacity sales to the paper industry in recent years was reported in wood- and bark-burning boilers (which increased from 8% of the 1972 total to 48% of the 1979 total), they declined to 38% of total capacity in 1980, and 19% in 1981.

Sales of coal-burning boilers increased significantly in 1980, accounting for 24% of total capacity sales, the largest percentage of coal-burning boiler capacity sales in the ten-year study. The relative decline since 1979 in orders for black liquor and bark/woodwaste boilers (Figure 4) reflects the fact that many pulp-producing mills had already expanded capacity relative to the availability of these fuel sources. To order copies of this API report, see the Bookshelf section of this issue (p. 179). □

FIGURE 2: **Energy use per unit of output in million Btu/ton**

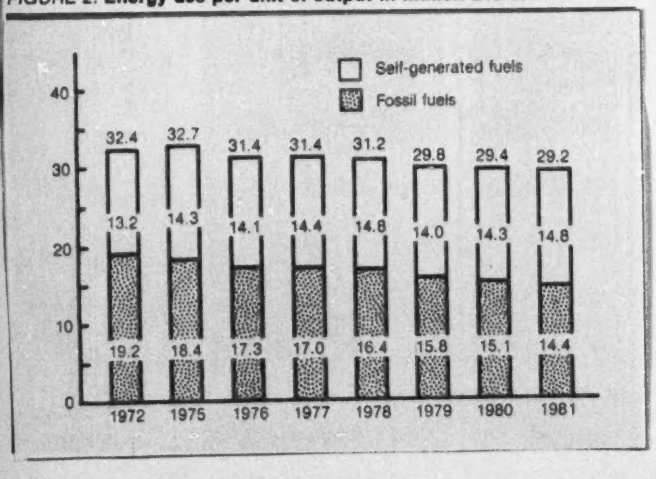


FIGURE 3: **Changes in the types of fuel used in boilers**

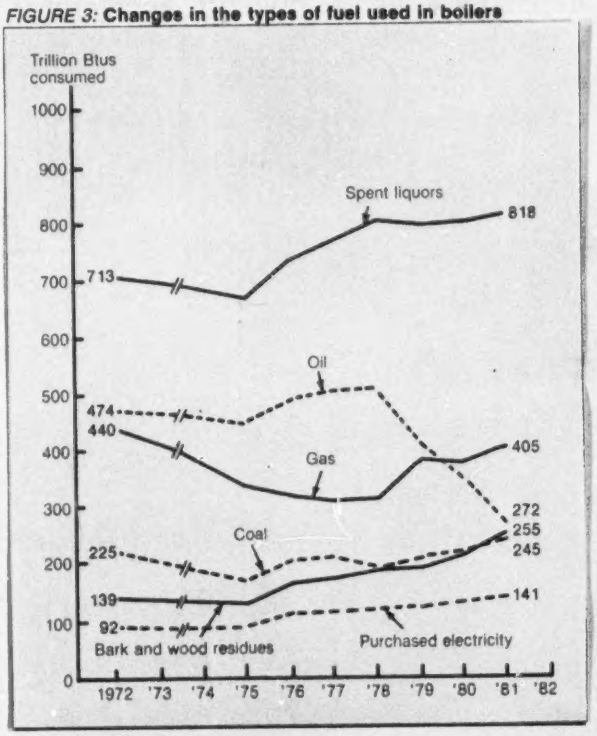
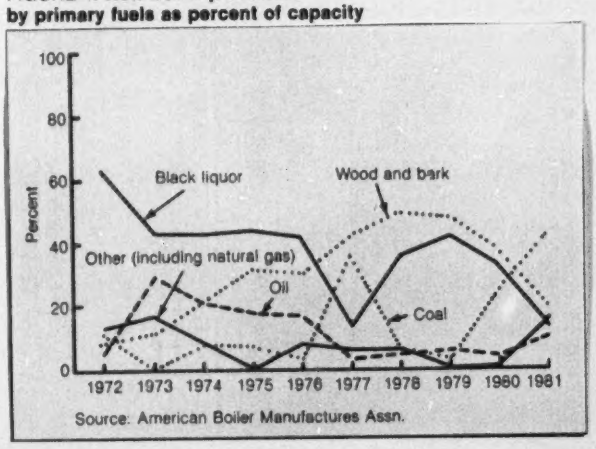


FIGURE 4: **New boiler purchases by primary fuels as percent of capacity**



Composting offers alternative for effluent plant sludge disposal

Disposing of sludge by composting is found to be economical, environmentally sound, and to produce a valuable byproduct from waste

By JOEL E. ALPERT, ELIOT EPSTEIN and CAROL DE GROOT

☐ Composting, the microbial degradation of organic material, is familiar to many people as a relatively simple means of converting garden debris and food scraps into a rich organic humus. In recent years, this same process has received increasing attention as a method for transforming municipal sludge to agricultural and landscaping use. In particular, many municipalities have adopted composting as a cost-effective and environmentally sound method for sewage sludge disposal. The EPA is actively encouraging development and implementation of composting systems, and several states are following suit.

Composting of both municipal and industrial organic wastes offers several advantages over other disposal methods:

- It converts a waste into a valuable material that can be marketed and used in a variety of applications.
- The process requires little capital investment, and is extremely flexible in the labor-to-capital ratio.
- The operation can be rapidly implemented.
- The process uses little energy.

Pulp and paper mill sludges, in particular, have proven highly suitable for rapid biodegradation through composting. These wastes have traditionally been deposited in landfills or incinerated, but environmental regulations and economic considerations have led many mills to seek alternative disposal methods. Studies by E&A Environmental Consultants have shown a broad range of pulp and paper mill sludges to be excellent candidates for composting. In general, sludges should have the following characteristics: dewatered primary and secondary sludges, or a mixture of both; volatile solids of 40% to 60%; ash content of 35% to 50%, and pH of 5.5 to 9.5.

Dr. Alpert and Dr. Epstein are chief environmental scientists, and Ms. de Groot is a scientist at E&A Environmental Consultants, Stoughton, Mass.

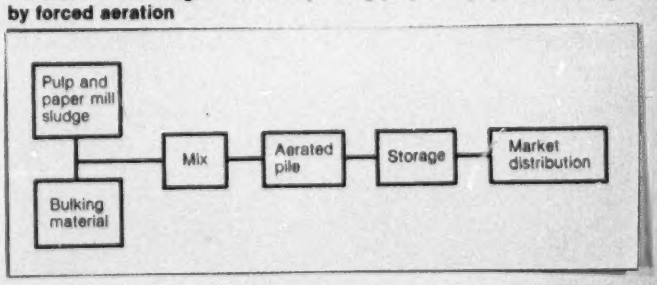
The heavy metals content of the sludge will not affect the process. However, if the resulting compost contains high levels of heavy metals, it may have to be restricted to nonagricultural uses in order to comply with EPA regulations. This requirement should not affect product marketability, since compost is usually distributed to nonagricultural users. If a sludge contains toxic organics, many of these compounds will be degraded during composting to produce an environmentally acceptable product. The presence of calcium, clay, phosphorus or lime in a sludge may actually enhance the product's value.

Process description

In 1974, the U.S. Dept. of Agriculture developed an improved method of composting. Known as the forced-aeration or "Beltsville" method, the process works by mechanically drawing air through the pile of composting material. The fan used in the process may be reversed to blow air through the pile once pathogen (disease microorganism) destruction is achieved. This method of aeration ensures more reliable, more uniform composting than the traditional "garden variety," or windrow, method in which the compost piles are turned over several times for aeration. The forced-aeration method has proven highly effective on pulp and paper mill sludges.

Figure 1 illustrates the process flow. Sludge is mixed with a bulking agent to the correct ratio. The purpose of the bulking agent is to provide uniform porosity so that air may be drawn or blown through the entire composting pile, and to lower the moisture content of the sludge. The bulking agent may be a variety of materials. Generally, the most available and useful agents are bark and

FIGURE 1: **Flow diagram for composting pulp and paper mill sludge by forced aeration**



woodchips. Mixing can be achieved by several types of equipment, depending on the quantity of sludge to be handled. Following mixing, the combined sludge-bulking agent material is gathered and placed in an aerated pile.

Figure 2 is a schematic of a forced aeration composting system. The basic steps in constructing a pile are:

1. A loop of perforated 4-in. plastic drainage pipe is laid on the site surface. The configuration will depend on the amount of sludge to be handled daily.

2. The pipe is covered with 8 in. to 12 in. of bark, wood chips or unscreened compost. This layer absorbs leachate from the pile and prevents pipe clogging.

3. Sludge and bulking mixture is placed on top of the pipe by a front-end loader to a height of 8 to 9 ft.

4. The pile is covered with a 6- to 8-in. layer of compost. This layer insulates the pile and helps maintain uniform temperatures throughout the mass.

5. The perforated pipe is connected through a section of solid pipe to a blower. The blower size depends on the system employed. A single blower controlled by a timer will handle 20 to 30 dry tpd of sludge.

The individual piles may be modified to form an extended system in which each day's sludge mixture is piled consecutively, utilizing the shoulder of the previous day's pile. This results in considerable saving of space, cover material, and base.

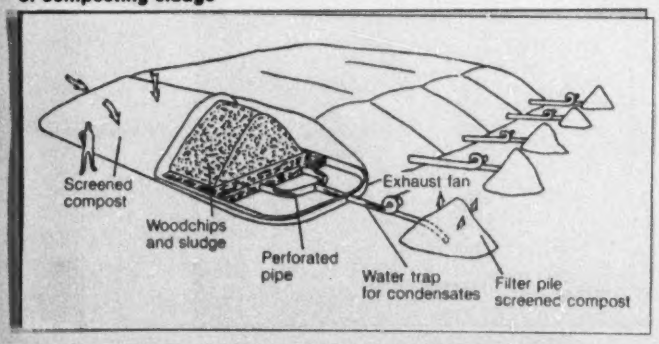
Once the blower is started, air is drawn or blown throughout the pile at a controlled rate, providing optimal conditions for microorganisms to effectively degrade the material. Time required for composting depends on degree of stabilization required and the type of sludge being composted, and can vary from two to six weeks.

Following composting, the material may be screened to separate the bulking agent from the compost. Screening allows recycling of the bulking material, and provides a more attractive, more uniform product. Screened compost may be marketed immediately or stored.

Site requirements and process parameters

The surface of a composting site must be sufficiently compacted for all-weather operation. Former landfill sites may be used, or a site can be prepared using gravel, asphalt, or concrete. A one-acre site will handle approximately 7 to 8 dry tons of sludge (35 to 40 tons at 20% solids). No special cover or housing is necessary, even in extreme weather conditions. Composting of sewage sludge is now being done in the open at Bangor, Maine, Windsor, Ont., and other northern municipalities, without any weather-related problems.

FIGURE 2: **Schematic diagram of forced aerated pile method of composting sludge**



Leachate from compost piles is minimal and, if necessary, can be collected and returned to the treatment plant or applied to the land by irrigation.

The composting process will be most efficient and cost-effective if performed under optimum and controlled conditions. Several parameters, such as oxygen level, free pore space, moisture content, and carbon/nitrogen ratio must be considered in light of the unique characteristics of each sludge. These parameters can be determined rapidly and efficiently, using a bin composter designed expressly for that purpose.

Compost marketing

As with all marketing questions, it is impossible to prescribe a solution that will be specific for each mill situation. An important aspect of any feasibility study of composting will be an analysis of possible utilization options. Factors that will affect the utilization of the compost, potential uses for the compost, and alternative distribution scenarios are discussed below.

The primary factors that will determine the best use for the compost are as follows:

- Quality of the compost
- Distance to the market
- Volume of compost produced
- Potential for in-house utilization.

The quality of the compost produced from pulp and paper mill sludge is a direct reflection of the sludge from which it is produced. The sludge is a combination of organic matter, conditioning chemicals, clays, and other inert materials; therefore, the compost is made up of the same material. Depending on the proportions of these materials, the compost can either be an excellent general soil conditioner, or be useful for specialized markets only. A second aspect to be considered is the distance from the source of production to the market. Since compost has a low weight per unit of volume, transport costs can be a significant element in the overall cost. It is possible to overcome this problem by enhancing the compost through nutrient addition or by bagging. Either option will add to the cost of production, but could open up a specialty market that would offset the additional costs.

A third issue is the volume of compost that will be produced. It is important to balance supply with the demand for compost. If several facilities are producing compost in the same area, it may be logical to develop a single brand name so that it will be easier to market the material. Alternatively, it might be necessary to utilize the compost for lower-value uses to ensure that it can all be sold, rather than try to obtain top prices.

Finally, a mill should explore the potential uses for the compost internally. For example, the compost can be used in reforestation efforts, as a potential odor scrubber, or as a source of fuel for the mill boilers.

Historically, the largest users of composts have been in agriculture and landscape work. People in these businesses are constantly looking for stable sources of high-quality, uniform organic matter to enhance the quality of their soil. In the past several years, rapidly escalating costs for peat have made it uneconomical for many uses. Consequently, these users might be an ideal market for certain pulp and paper mill sludge composts.

Due to its high exchange capacity, compost has proven to be an excellent medium for absorbing odor. For years, Europeans have utilized compost in this manner. And a

sewage treatment plant in Windsor, Ont., is utilizing compost it produces to scrub plant odors.

A third use of compost would be as boiler fuel. The composting process utilizes biological energy to drive off water in the sludge. In the biological process, the volatile components of the sludge are converted into energy, which is available to vaporize the sludge water. The net result is a product (compost) that is easier to handle, has a lower moisture content, and is more easily stored than the sludge from which it is produced.

Process economics

In the following example, compost costs are developed for a hypothetical mill producing 10 dry tpd of 20%-solids sludge. The compost facility will be moderately capital-intensive and will be located close to the source of sludge. Costs in this analysis are based on 1982 prices. These costs and the final site design would, of course, be modified to take into account such factors as availability of land, costs of labor, capital funding availability, and source and type of bulking agent. With composting it is comparatively easy to design a very basic and inexpensive facility utilizing existing plant equipment, and then to upgrade the compost site as necessary over time.

This analysis assumes that all new equipment will be purchased and new personnel will be hired. The experience of the authors is that most plants have at least some available equipment, as well as plant personnel already involved in sludge handling.

Capital requirements are summarized in Table 1. These costs are based on a fully paved, contoured compost site, and include a building for compost drying and screening. This building is necessary if the bulking agent is unavailable, or if there is a constant need for the compost product. If bark is plentiful, is utilized as the bulking agent; and if the compost will be used on the plant's grounds, then it might be possible to operate the screens only at infrequent intervals. Consequently, the drying building would not be necessary. Also, if compost is to be used as fuel in the boilers, it might be possible to reduce the building size and eliminate the screening option.

Total capital costs for the 10-ton compost site described above would be $699,062, including the drying building, screening/grinding equipment, and their related engineering and contingency costs.

Operating and maintenance costs are shown in Table 2. Two people are required to operate the facility. It may be necessary to augment this labor with another person for certain tasks, depending on the end use of the compost and other engineering and design factors. In this analysis, it is assumed that bark or other suitable bulking agent can be obtained at no cost. The total operating and maintenance costs are about $133,000/year. These operating costs are quite conservative in nature, since a very high annual maintenance cost amounting to almost 4% of the total annual costs is assumed. It is doubtful that such costs would be incurred for the first several years of operation, at least.

The annual costs are the sum of the amortized capital costs and actual operating expenses. For the site costs calculations, a 15% interest rate and 20-year amortization period was used; for the moving equipment, a 15% interest rate and 10-year amortization was used.

Total annual amortization costs, including the building and screen/grinder, are $106,595/year. If the building and screen are not needed, the annual amortization costs drop to $55,563. Total costs, including operating costs, are then $239,964 for the most costly option, and $164,932 for the facility with no building or screen. This works out to a cost of $63.43 to $92.29/dry ton of sludge, or $12.68 to $18.46/wet ton of sludge, based on a 5-day/week operation.

Each dry ton of sludge will produce approximately 6.5 yd^3 of compost for marketing. Compost from municipal treatment plant sludge has been sold for between $3.00 and $12.00/$yd^3$ in bulk. Using these figures, it seems possible to recover between $19.50 and $78.00/dry ton of sludge composted. This income can substantially offset the costs of treating the sludge by this environmentally effective manner. P.H. Glatfelter Paper Co. (a detailed article on this installation will appear in a future issue of PULP & PAPER) is currently selling its compost, which reduces operating costs at its Spring Grove, Pa., mill.

Another positive aspect of composting is that most of the annual operating costs can be quite carefully controlled. Very few of the costs are subject to inflationary pressures. Energy costs in particular are quite low.

A factor that has not been considered in this analysis is the effect of investment tax credits and other tax credits, which could be associated with implementing a composting operation. □

TABLE 1: **Capital costs for 10-dry-tpd composting plant**

Site	Unit cost	Cost
Cleaning/grubbing	$ 0.62/yd^2	$ 4,803
Grading	1.00/yd^2	7,747
Base and paving	12.00/yd^2	92,961
Drainage pipe	20.00/linear ft.	7,041
Electrical	lump sum	10,000
Building[1] (slab, frame, and roof)	20.00/ft^2	200,000
Blower stations	2000.00 each	20,000
Subtotal site costs		$342,552
Moving equipment		
Front-end loader		120,000
Moving device		50,000
Screen/grinder plant[2]		70,000
Subtotal moving equipment		$240,000
Subtotal capital costs		585,552
Engineering and contingency costs		116,510
Total capital cost		$699,062

1. Building for screening and compost drying is optional, depending on site and compost use.
2. Screening plant is optional, depending on compost use.

TABLE 2: **Operating costs for 10-dry-tpd compost site[3]**

Item	Unit cost	Annual cost
Labor	$16,000/person/yr	$ 32,000
Fringe	30% of labor	9,600
Disposable pipe	$ 0.25/ft	6,641
Maintenance	5% of site costs[1,2]	17,128
	20% moving equipment cost[1,2]	48,000
Energy		
Diesel fuel	$1.20/gal	12,000
Electricity	$0.06/kwh	8,000
Total annual operating costs[3]		$133,369

1. Based on five day/week operation.
2. Operating costs include building, screens, and grinder.
3. Assume bulking material available at no cost.

Timber ownership still big factor for success in the paper industry

Survey of timber ownership, valuation, and self-sufficiency shows Weyco still leading in timber value, with IP next, followed by Georgia-Pacific

By THOMAS P. CLEPHANE and JEANNE CARROLL

☐ Timber ownership should continue to be an important element for success of companies in the increasingly integrated forest products industry. At normal levels of economic activity, there has been a long-term squeeze on the availability of accessible timber of desirable species and quality, primarily for softwood pine and fir in the Northwest and the South. This condition has resulted in a sustained and substantially faster rate of increase in both western and southern timber prices than in the general inflation rate over the past five to ten years.

From late 1981, timber prices are expected to rise 1% to 3% faster than inflation for the following reasons:

- Although demand is expected to moderate because of a lower level of housing starts, the decline in the rate of increase of timber growth should be even greater. As a result, the substantial gap that exists between timber harvest and growth at present should narrow appreciably.
- The Forest Service forecasts a 32% drop in supplies from forest industry lands in the Northwest by 1990, owing to persistent overcutting of old-growth timber and the extended time period—at least 20 years—before new growth reaches maturity.
- The U.S. is the low-cost timber and paper producer for expanding export markets in Asia and Europe.

Because much of the expected rise in demand reflects stronger markets for pulpwood, primarily in the South, prices of southern softwood timber are expected to rise faster than those of western grades, and values for pulpwood as well as sawtimber should increase in real terms.

Thomas P. Clephane is a vice-president and Jeanne Carroll a security analyst in the research department of New York-based investment firm, Morgan Stanley & Co. Their recently released 153-page biannual Timber Survey covers holdings of 97 companies.

Importance of timber ownership

Timber as a raw material is a significant element in the total cost of producing wood and paper products.

In the wood products area, the companies that have grown the fastest have owned low-cost timber bases. Profits from harvesting owned timber have provided a rising level of sustainable earnings taxed at the 28% capital gains rate, while the manufacturing value added has been extremely volatile.

With timber far-and-away the single-largest element of manufacturing costs (60% to 70% of the total), the major timber-owning companies have been expanding their market shares in the fragmented, slow-growth wood products industry. From 1969 through 1979, Georgia-Pacific Corp. and Weyerhaeuser Co. increased their combined lumber and plywood production at a 7% compound annual rate, while total industry output rose only 2%/year.

In the sharp 1979-81 contraction, these two dominant companies showed only a 5% drop in lumber and plywood output, as their market share increased strongly in the face of large declines in industry output. During the anemic housing recovery expected for 1983-84, nonintegrated producers should be hard-pressed to earn more than marginal profits because of the severe cost pressures from high-cost timber contracts arranged from 1979 through mid-1981. A substantial contraction in western wood products output is expected, with business continuing to shift to the South, where timber, labor, and freight costs are lower.

In the paper area, timber ownership is less important than in the wood products sector because labor and capital costs are relatively higher. The cost of delivered timber, which includes a substantial element of labor input in harvesting and delivery, amounts to 20% to 30% of total manufacturing costs, with labor representing another 20% to 25%. The industry is very capital-intensive, with a one-to-three ratio of sales to plant investment. There are examples of paper companies with small timber resources whose success has resulted from concentration on specialty products or the above-average efficiency level of their manufacturing plants. But timber ownership should continue to be an important advantage for certain companies in the paper industry, particularly for more timber-intensive products like linerboard.

Rising investment in timberlands

The increasing value of timber assets and the low-cost position of the U.S. in world markets makes timber ownership appealing for corporate and individual investors both within and outside the existing industry.

At least 30 publicly owned companies have acquired substantial amounts (at least 50,000 acres) of timberland since 1973, including 15 of the largest forest products and paper companies, most of which have publicly announced programs for the continuing purchase of timberland. Fifteen other firms, including nine diversified companies, also have acquired considerable timber holdings. In addition, purchases by private companies or investment syndicates have increased significantly in the past two years, with ten separate private transactions involving timber properties.

With capital investment costs still rising and stock values depressed, forest products and paper companies may find that an acquisition, even at substantial premiums over present stock prices, is the cheapest way to increase timber as well as plant assets. Since 1976 there have been 28 acquisitions completed in the U.S., each with a transaction value of over $60 million, for a total consideration of $6.04 billion in cash and stock. Ten of the deals involved plant assets only, six involved timber assets only, and 12 involved timber as well as plant assets.

Since early 1980, there have been 14 separate purchases of timberland with a minimum value of $25 million, encompassing every region of the U.S. Total value of these timber purchases was $1.2 billion. In addition, there was a frenetic round of acquisition activity in Canada during the 1980-81 period, involving nine separate transactions and total payments of US$3.05 billion.

Methodology of timber survey

Timber holdings for the 22 largest paper and forest products companies, categorized into eight geographic regions within North America, are shown in Table 1. Owned acres only are considered, since timberland controlled as a result of most types of stumpage contracts does not carry guaranteed fixed prices and/or long-term supply.

Although the subject of stumpage agreements is very complex, there are generally three categories other than fee ownership:

1. Goverment timber sale contracts are most prevalent in the West and usually contain a three-year limit on cutting rights. Prices are fixed according to competitive bidding west of the Cascades, and the contracted volume must be cut within the limit of the term; in other areas, there are escalation/de-escalation clauses tied to end-product prices;

2. Canadian provincial licensing arrangements are usuallly long-term in nature, with escalation clauses tied to end-market prices;

3. Timber purchase agreements are most prevalent in the South, where there is substantial private timber ownership. In some limited cases, these contracts can be considered similar to private ownership rights, with fixed payments for the timber and supply guaranteed over the

TABLE 1: **Acres owned in North America (at year-end 1981; thousand acres)**

	United States						Canada		
Major forest products/ paper companies	**North-west**	**Inter-mountain**	**Calif.**	**South**	**Central**	**New England**	**British Columbia**	**Eastern**	**Total**
Weyerhaeuser	2215	655	—	3002	—	—	—	58	5930
International Paper	377	—	103	4622	375	1425	—	—	6902
Georgia-Pacific	597	—	200	2554	302	580	—	380	4613
Crown Zellerbach	664	185	—	856	—	—	274	—	1979
Champion International	308	683	148	1454	434	—	42	—	3069
St. Regis Paper	153	311	—	1516	156	1078	—	—	3214
Boise Cascade (A)	284	1158	—	554	327	715	—	24	3062
Pacific Lumber	—	—	167	—	—	—	—	—	167
Scott Paper	242	—	—	740	—	862	—	1002	2846
Potlatch	—	614	—	554	247	—	—	—	1415
Union Camp	—	—	—	1728	—	—	—	—	1728
Louisiana-Pacific	—	130	570	150	48	—	22	—	920
Willamette	222	—	—	250	85	—	—	—	557
Mead	—	—	—	752	824	—	—	—	1576
Great Northern Nekoosa	—	—	—	366	258	2159	—	—	2783
Longview Fibre	342	84	57	—	—	—	—	—	483
Masonite (B)	—	—	106	361	22	—	—	—	489
Westvaco	—	—	—	525	750	—	—	—	1275
Kimberly-Clark	—	—	—	564	—	—	—	104	668
Chesapeake Corp. of Va.	—	—	—	364	—	—	—	—	364
Federal Paper Board	—	—	—	380	—	—	—	—	380
Hammermill Paper	—	—	—	176	183	—	—	—	359
Total	**5404**	**3820**	**1351**	**21,468**	**4011**	**6819**	**338**	**1588**	**44,779**

(A) Southern timberland includes 50% of 651,000 fee and fixed lease acres in Boise Southern (La.) and 228,000 net acres in the Carolinas, including a 25% interest in 90,000 held by a separate investment partnership.
(B) In early August, the company announced plans to spin off its timberland and lumber properties to a liquidating partnership to be owned by the shareholders. The limited partnership to be created is subject to Masonite Corp. shareholder approval.
Source: Morgen Stanley

life of the contract—which typically runs 30 to 60 years. Most of these agreements have some form of escalation, usually tied to a broad price index. Because most of the contracts were signed in the 1950-60 period, stumpage payments in some cases are substantially below current timber values and represent a significant corporate asset.

International Paper Co. is the largest timber owner in acreage, with 6.9 million acres in North America, followed by Weyerhaeuser with 5.9 million acres, G-P with 4.6 million, and Crown Zellerbach with 2.0 million. In addition, a number of "diversified" companies not shown own substantial acreage—such as Bowater Corp., with 2.7 million acres; Time Inc., 1.6 million; Burlington Northern, 1.5 million; Continental Group Inc., 1.5 million; ITT Rayonier Inc., 1.2 million; and Procter & Gamble Paper Products Co., 1.0 million. Largest Canadian paper company timber owners are CIP Inc., with 1.4 million acres and MacMillan Bloedel Ltd., with 1.1 million acres.

A sharp variance can be found in commercial timber inventory per acre in different regions. The Northwestern regions have been narrowly defined to include only Washington and Oregon (west of the Cascade Mountains). This region is primarily composed of Douglas fir, the most dense and valuable timber stands. Timber stocking becomes less dense in the Intermountain region of eastern Washington and Oregon, California, Idaho, and Montana, since rainfall is not as great and also because of the predominance of pine species. In addition, it is important to note that timber stands are about two-and-a-half to three times more dense in the Northwest than in the South.

Estimates of commercial timber inventory for various companies are shown in Table 2. Because of the higher timber density in the Pacific Northwest, Weyerhaeuser ranks first in timber inventory, followed by IP and G-P.

Estimated value of timber assets

In translating these inventory figures into valuation data, best estimates for market value of sawtimber, pulpwood, and land were used for each of the eight geographic regions—with a common 25% volume discount applied to all of the figures above $1 billion in value. In normal economic times, timberlands with an economic value of $1 billion could change hands without a significant discount, but in the present depressed economy, the market for large volumes of timber has dried up.

Timber in the Northwest and Intermountain regions is almost exclusively more valuable sawtimber, while timber in the Northeast and Central regions is assumed to be predominantly pulpwood. Southern timber values are composite, reflecting the present harvest pattern of 40% sawtimber and 60% pulpwood.

Because of the wide differences in timber stocking and values, the average acre of timberland in the Northwest has a market value (before the 25% discount) of $3280; in the Intermountain region, $800; in the South, $735; and in the Northeast, $188. The wide disparity in these figures points up the need to focus on a more sophisticated measure of timber-ownership value than total acres owned.

The estimated value of timber and land owned by the top 22 companies is also shown in Table 2. These figures

TABLE 2: **Estimated timber valuation**

Major forest products/ paper companies	Timber inventory (million ft³) Total	Pacific Northwest	U.S. South	Other	Estimated value timber & land (A) (millions $)	Timber & land book value	Estimated timber value/ book value ratio	Estimated timber value /share ($)
Weyerhaeuser*	10,814	6986	2930	898	8035	620	12.96	60
International Paper	8563	566	5668	2329	3607	781	4.62	73
Georgia-Pacific	6010	1194	2894	1922	2781	752	3.70	25
Crown Zellerbach	3358	1610	1070	678	2049	259	7.91	69
Champion International*	3541	379	1325	1837	1686	465	3.63	28
St. Regis Paper*	4068	442	1421	2205	1557	218	7.14	45
Boise Cascade*	3748	568	549	2631	1502	290	5.18	56
Pacific Lumber	1336	—	—	1336	1167	4	291.75	45
Scott Paper	3371	581	770	2020	1083	92	11.77	25
Potlatch*	2446	—	720	1726	977	214	4.57	64
Union Camp	1728	—	1728	—	914	160	5.71	38
Louisiana-Pacific	1678	—	173	1505	886	189	4.69	29
Willamette	1057	622	350	85	955	327	2.92	63
Mead	1816	—	827	989	697	43	16.21	26
Great Northern Nekoosa	2871	—	402	2469	660	86	7.67	41
Longview Fibre	713	547	—	166	612	103	5.94	54
Masonite	580	—	289	291	466	43	10.84	38
Westvaco	1350	—	525	825	462	143	3.23	18
Kimberly-Clark	682	—	620	62	420	36	11.67	18
Chesapeake Corp. of Va.	291	—	291	—	216	33	6.55	34
Federal Paper Board*	286	—	286	—	215	59	3.64	28
Hammermill Paper	444	—	188	256	163	33	4.94	19
Total	**60,751**	**13,495**	**23,026**	**24,230**	**31,110**	**4950**	**6.28**	

*Timber inventory estimated by company
(A) Note: Volume discount has been applied to timber values above $1-billion. This 25% discount applies to the first 12 companies.
Source: Morgan Stanley

should be considered gross approximations, but they are useful in comparing relative timber asset values for each company.

Weyerhaeuser, with timber inventory valued at about $8.0 billion, is the dominant owner of timber. IP is a distant second, with $3.6 billion, and G-P is third with $2.8 billion. The timber holdings of the 22 major paper/forest products companies total 44.8 million acres, with an appraised value of $31.1 billion. This appraisal represents a 14.6% decline from the aggregate value of $36.4 billion for 45.4 million acres published in the 1980 Morgan Stanley Timber Survey (P&P, Nov. 1980, p. 72).

Estimated timber value for the 22 companies is 6.3 times greater than the $4.95 billion stated book value of their timber assets. Combined book value of nontimber assets for the 22 leading companies totals $18.3 billion, comprised of $24.8 billion in-plant plus $5.5 billion in working capital, with deductions of $10.8 billion for long-term debt and $1.2 billion for other net liabilties (mostly deferred taxes).

Adding the appraised timber value of $31.1 billion results in an aggregate timber-adjusted book value figure of $49.4 billion. This compares with a stated combined book value of $23.2 billion and an aggregate stock market value of $16.4 billion. It is apparent that combined market value of the 22 major companies in the industry is 29% below stated book value and at a substantial 67% discount to timber-adjusted book value.

Timber consumption and self-sufficiency

Table 3 presents data used to calculate each company's timber self-sufficency ratio of growth relative to consumption. Consumption of timber has been estimated for major categories of paper and wood products using common conversion factors. Timber growth factors have been developed by applying growth rates for each region adjusted for its quality (primarily a function of soil type, rainfall, etc.) and the magnitude of a company's long-term investment in intensive forestry management (or plantation) programs. Derivation of the annual growth rate is based on Forest Service studies and discussions with companies and forestry consultants.

The standard measure of self-sufficiency relates a company's present harvest to its total net consumption requirements. This measure of current self-sufficiency shows that only Weyerhaeuser and Pacific Lumber Co. supply virtually all of their consumption needs from their present harvests. CZ, Potlatch Corp., and G-P are at least 51% self-sufficient, followed by Boise Cascade Corp. at 46%, Champion International Corp. at 45%, and Scott Paper Co. at 43%.

A second measure of self-sufficiency relates timber growth (with the present level of plantation acreage) to current consumption. This calculation indicates that five companies (mostly western-oriented) are harvesting at a level somewhat in excess of growth, while another six firms are in rough balance. The data indicate that four companies—Chesapeake Corp., Kimberly-Clark Corp., Federal Paper Board Co., and Longview Fibre Co.—have current timber growth that is at least double their 1981 harvest, so that they can increase their cut meaningfully as these plantations mature. Union Camp Corp. and IP are growing about 70% more than the present harvest, while Hammermill Paper Co. is growing 56% in excess of cut. Union Camp has 49% of its acreage in plantations, the highest percentage among the major companies. □

TABLE 3: **Timber consumption and growth data**

Major forest products/ paper companies	(Million ft³) Timber inventory	1981 net consumption	Estimated timber growth	1981 timber harvest	Timber growth to inventory	Ratio of timber growth to consumption	Timber harvest to consumption
Weyerhaeuser*	10,768	762	661	743	6.14	86.75	97.51
International Paper*	8563	782	453	274	5.29	57.93	35.04
Georgia-Pacific*	5706	687	327	350	5.73	47.60	50.95
Crown Zellerbach*	2865	268	162	180	5.65	60.45	67.16
Champion International*	3539	397	224	177	6.33	56.42	44.58
St. Regis Paper*	4068	397	165	130	4.06	41.56	32.75
Boise Cascade*	3731	376	154	172	4.13	40.96	45.74
Pacific Lumber	1336	19	22	19	1.65	115.79	100.00
Scott Paper*	2549	230	101	99	3.96	43.91	43.04
Potlatch	2446	151	78	94	3.19	51.66	62.25
Union Camp	1728	302	156	90	9.03	51.66	29.80
Louisiana-Pacific*	1656	275	73	55	4.41	26.55	20.00
Willamette	1057	146	53	44	5.01	36.30	30.14
Mead*	1816	313	93	69	5.12	29.71	22.04
Great Northern Nekoosa	2871	293	79	95	2.75	26.96	32.42
Longview Fibre	713	82	52	22	7.29	63.41	26.83
Masonite	580	122	48	42	8.28	39.34	34.43
Westvaco*	1350	221	79	77	5.85	35.75	34.84
Kimberly-Clark*	620	102	51	19	8.23	50.00	18.63
Chesapeake Corp. of Va.	291	67	29	9	9.97	43.28	13.43
Federal Paper Board	286	93	34	13	11.89	36.56	13.98
Hammermill Paper	444	131	25	16	5.63	19.08	12.21
Total	**58,983**	**6216**	**3119**	**2789**	**5.29**	**50.18**	**44.87**

*U.S. operations only

Source: Morgan Stanley

Sudden roofing felt shift to glass slashes organic mills' market share

Glass mat roofing felt machines to make 60% of all shingles in 1982; four new fourdriniers now on order and several more still under study

By DAVID R. ALLAN, News Editor

☐ Depressed conditions in the housing market have driven building products companies into their deepest tailspin of the postwar era, and yet virtually all producers of roofing felt have either invested in new capacity in recent years or are studying plans to do so—and not an ounce of the fiber for those new machines will come from wood. Despite the most dramatic building products capacity swing in recent years, however, the technology being used by the new installations is fairly familiar to the paper industry: the inclined-wire fourdrinier.

Exciting though a major capacity switchover may be, the depressed condition of the housing industry means companies are basically stealing market share from their organic felt machines to give to their fiberglass mat machines. And the end result of the 50% increase in capacity scheduled for the next 12 months—with four new Sandy Hill machines scheduled to come on-line between October 1982 and the end of 1983—could be that organic felt machines can't be shut down fast enough to keep the new units going full-out.

Insignificant in the roofing industry until the late 1970s, glass shingles gained market share with the rising price of asphalt, and market share began to explode in 1980 and 1981. Representing about 18% of asphalt roofing in 1980 according to Census Bureau figures and 42% to 46% in 1981 according to industry executives, fiberglass-based shingles should take close to 60% of the total shingle market this year, with glass rolls taking 50% of the smaller built-up roofing market, according to industrial consultants John Starr and Zeb Renaud. Starr and Renaud, authors of an extensive study on this area published in 1979 and recently updated, believe that share could rise to 81% by 1987.

Shingle demand weak. The market is smaller in 1982 than it was in the late 1970s, due to the housing depression, of course. Therefore, roofing felt mill operating rates for all of 1982 will not reflect a runaway market.

The Asphalt Roofing Manufacturers Assn. estimates total production tumbled by 22% between 1979 and 1981. One manufacturer said about 309,000 tons of glass and organic mat went into roofing shingles and commercial roofing rolls in 1981. About 124,000 tons of this is glass mat, which is expected to rise to over 160,000 tons in a 1982 roofing market that should remain close to 300,000 tons of total production.

One executive calls the changeover an artificial market shift being forced by producers idling old organic felt mills to get maximum-possible running time in a soft market out of their new glass mat units—thus keeping ahead of financing costs. Demand for shingles and roofing rolls in 1982 was expected to be about level with 1981, with only a slow gain projected for 1983. Consumers have shown no striking preference for one type of shingle over the other.

Starr and Renaud think production of glass mat for shingles will rise from 50,000 tons in 1979 to 158,000 tons in 1982—and to 270,000 tons in 1987. Since demand for roofing products is not expected to rise at the same rate, that implies shutdown of a significant amount of organic felt capacity.

Machines running full-out. This fall, both fiberglass mat machines and units producing organic felt were enjoying healthy operating conditions, with glass machines running virtually full-out in most cases. Most roofing felt mills took extensive downtime during an unusually slow first quarter, and observers say inventories virtually disappeared. Then, when the building season got into full swing in the summer, mills began running on heavy schedules to catch up. As a result, both roofing prices and fiberglass strand prices have begun to recover from early 1982 softness. Once the building season is over, many observers think extensive downtime will once again become common.

Even with a rising market share, times have not been easy even for companies that have converted to the new technology: one executive's estimate places total glass mat paper machine capacity installed in 1981 at 157,000 tpy in fourdriniers and a further 15,000 tpy in dry-process machines, indicating the glass mat portion of the industry was running at about 72% of capacity last year.

Although glass mat market share will grow this year, capacity grew by about 23,000, too; the startup of Celotex Corp.'s new four-meter Sandy Hill unit in Russel-

ville, Ala., kept operating rates below 90% for the year as a whole.

Twelve units installed. Only about 12 glass mat fourdriniers had actually been installed through the end of the third quarter of 1982. In addition to the four new machines now on order, other new capacity, which is believed to be under study, could complicate the situation further in the future.

Celotex designed its Russelville,Ala., mill with at least one more machine in mind. Georgia-Pacific Corp. now buys mat to produce roofing, but one observer suggested it will order a new machine as early as the first half of next year. IKO Industries Ltd., a Canadian company that this year bought a Bird & Son Inc. mill in Chicago, is thought to be another possibility for a new glass mat unit. GAF Corp. is also believed close to making a decision on a possible new machine.

Genstar Building Materials has placed an order that is typical of the type of machine now being bought by roofing products companies. Most are in the 60- to 80-tpd class, three to four meters wide—the Genstar unit is a four-meter machine, with a trim of 157.5 in., just 1.5 in. over four meters—producing a mat with 80% fiberglass and 20% binder. A typical binder would be urea-formaldehyde resin. Fourdriniers rather than cylinder machines—which are traditional for organic roofing felt—are used to produce wet-laid glass mat, with an inclined wire having an adjustable angle of inclination to allow for fiberglass's heavy drainage requirements, which can get up to 225 gpm/in. of face or more.

Dry process. Most glass mat is made by a wet process, although manufacturers such as Owens-Corning Fiberglas Corp.and CertainTeed Corp., as well as CertainTeed's French parent, Compagnie de Saint-Gobain, make some mat from a dry process using technology entirely alien to the paper industry. Some observers expect that the relatively slow production of the dry process will force its eventual abandonment in favor of wet-laid mat, and one executive pointed to OCF's choice of a fourdrinier for its new Aiken, S.C., capacity as a sign of that trend.

Sandy Hill Corp. and Voith Inc. are the major paper machine suppliers. Voith's machines are the outcome of cooperative efforts with Johns-Manville Corp.'s West German subsidiary, Glaswerk Schuller. The only machines now known to be on order in the U.S. are Sandy Hill's, while OCF has ordered a Voith four-meter machine for its European mill, with 1983 scheduled as the startup date.

All machines currently installed are in the Sun Belt, aside from two Johns-Manville machines in Waterville, Ohio. This is due to a problem with brittleness and cracking in the cold winters of the Northeast and Midwest. However, analysts expect product improvements to permit greater market penetration in the Frost Belt by the end of the decade, since a lower asphalt usage, longer life, and higher fire rating make glass shingles a more attractive product.

Market mat price worry. Uncertainties still plague this fast-growing market, however. Some felt producers, like Celotex, are considering joining Johns-Manville and OCF in producing their own glass strand in order to guarantee long-term fiber supplies.

Another concern relates to the expected overhang of fiberglass mat capacity in the next few years, which could force many producers to become aggressive sellers of market mat, depressing market mat prices. Currently Johns-Manville, with 38% of total glass mat capacity, is the major market mat producer, but Genstar's new machine may put it into a surplus mat position, and GAF could become a major market mat seller if it goes ahead with expansion plans.

European demand. While the U.S. glass mat market is growing at a rapid rate, European demand is rising at a more stately pace. However, Starr and Renaud project it will still increase by 40% between now and 1987, requiring approximately 54,000 tpy of mat at that time.

Europe's industry regularly shuts down machines for several weeks a year and typically gets much less production for the size of the equipment. According to Renaud, the two major producers of roofing felt in Europe are Saint-Gobain, with about 18,000 tpy of production using dry-process machines, and Voith, with about 16,000 tpy of production on two three-meter machines and a four-meter machine—the only such unit currently installed in Europe. Other producers active in European markets include Regina in the U.K.; OCF in the Netherlands; Isola in Norway; Ahlstrom in Finland; Andernach in West Germany; Vitrofil in Italy; and several others. None of these is believed to currently produce over 5000 tpy. □

TABLE 1: **U.S. fiberglass mat roofing felt machines**

Company	Location	Capacity (tpy)	Supplier
Celotex	Russelville, Ala.	23,000	Sandy Hill
CertainTeed	Athens, Ga.[1]	5500	CertainTeed
	Athens, Ga.[1]	5500	CertainTeed
CongLas	Bakersfield, Ca.	6000	Unknown*
Elk	Ennis, Tex.	20,000	Sandy Hill
GAF	Chester, S.C.	27,500	Voith-Schuller
Genstar	Los Angeles, Ca.	2000	unknown*
	Atlanta, Ga.	3000	unknown*
Johns-Manville	Waterville, Ohio	22,500	Voith-Schuller
	Waterville, Ohio[3]	22,500	Voith-Schuller
	Etowah, Tenn.	22,500	Voith-Schuller
Malarkey	Portland, Ore.	6000	unknown *
Owens Corning	Aiken, S.C.	18,000	Sandy Hill
	Santa Clara, Ca.[1]	1500	unknown
	Kansas City, Kan.[1]	1500	unknown
	Kansas City, Kan.[1]	1500	unknown
Tamko	Tuscaloosa, Ala.	7000	unknown*
Machines on order or reported to be under study			
Bird	Charleston, S.C.	25,000	Sandy Hill
Elk	unknown[2]	unknown	unknown
GAF	unknown[2]	unknown	unknown
Genstar	Ennis, Tex.	25,000	Sandy Hill
Johns-Manville	Etowah, Tenn.[2]	22,500	Voith-Schuller
Owens Corning	Aiken, S.C.	25,000	Sandy Hill
Tamko	Joplin, Mo.	18,000	Sandy Hill

1. Dry process machines
2. Reported to be under study
3. Partially converted to produce specialty grades other than roofing
* Believed to have been produced by independent entrepreneur Dan Appels
Source: PULP & PAPER estimates; John Starr/Zeb Renaud estimates